NATURE

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ORGANIC CHEMISTRY

AN ADVANCED TREATISE

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Organic chemistry is richly endowed with excellent textbooks. However, there is a need for a general treatise of organic chemistry suitable for instruction at a graduate level. Such a book must focus attention upon new developments. At best, it can but serve the purpose of the moment and provide a point of departure for unceasing revision.

The idea of a collaborative work by specialists in the several branches of the science was developed in 1934. Each author was asked to prepare a chapter dealing with a subject of particular interest to himself. It was hoped to obtain, in this way, an authoritative treatise which would cover most of the important phases of organic chemistry. The execution of this plan has resulted in the present volumes.

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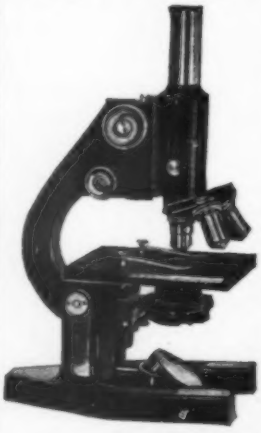

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International Science

FOR several years past we have been familiar with the spectacle of eminent men of learning being forced to leave their work either on racial grounds or because they do not accept particular political, religious or other limited views. The list of men of science in Austria who have recently been dismissed from their posts (see NATURE, June 18, p. 1101, July 2, p. 32), is a pertinent reminder that this state of affairs not only persists, but is even extending, and that the work of the Society for the Protection of Science and Learning needs continued and enhanced support.

Important as is the work of relieving the distress entailed by such proscriptions and establishing the victims in conditions under which they can resume their studies and benefactions to mankind, there are other insidious effects which may have even more serious consequences to the world if unchecked. No unprejudiced person questions the real impoverishment of science, for example, in those countries from which the evictions on such grounds have occurred. What is less apparent, however, is that the loss is one from which the whole world of science and learning suffers.

A striking example of this is to be found in the recently published review of the work of the Rockefeller Federation in 1937. From the beginning of its activities twenty-five years ago, the Foundation has been guided by the objective set forth in its charter : "The well-being of mankind throughout the world." The trustees have endeavoured to maintain the work of the Foundation on an international plan without consideration of political doctrines or creeds, believing that in a programme based on the advancement of knowledge it is imperative to disregard the geographical boundaries which arbitrarily and often unhappily divide the world into a patchwork of senseless antagonisms. In its search for high talent and promising opportunities, the Foundation has assumed that national frontiers are not the forbidding barriers they purport to be.

In recent years serious and increasing difficulties have been encountered in pursuing this policy. As Raymond B. Fosdick, president of the Foundation, points out, objective scholarship is possible only where thought is free, and freedom can exist only where there is tolerance and where there are no prohibitions on the inquisitive and questioning mind.

The progressive disintegration of creative scholarship, particularly in the social sciences and the humanities, which the world has recently witnessed in several countries, has already affected the programme of the Foundation. In some fields it is now profitless to go where it formerly went, and its work is stopped at some frontiers because behind them the search for truth by eager and sceptical minds has been made impossible.

It needs no profound acquaintance with the detailed activities of the Foundation and its many benefactions to mankind in all countries to realize the gravity of a situation which can draw such words from the president of the Rockefeller Foundation. In the last analysis, knowledge cannot be nationalized. Successful embargoes cannot be maintained against the export or import of ideas. We are all of us, under whatever national flag, the joint beneficiaries of the intellectual property of mankind. Science cannot but have a single aim and language in the discovery of truth or it ceases to be science.

Nowhere have the dangers of the present situation been more plainly set before scientific

workers. It is bad enough that the activities of such an organization as the Rockefeller Foundation should be circumscribed and certain countries deprived of the services it could render. This, however, is not the concern of those nations alone, for the whole world is impoverished by this state of affairs. Scientific progress depends on co-operation, and anything which limits the freedom of scientific work or scientific workers because they do not accept particular political or religious views, whether generally or in limited areas, is detrimental to the advancement of knowledge and the progress of mankind. The contact between keen and untrammelled minds of men of all races, supplies one of the most indispensable stimulants to scientific progress, and we hamper it at our peril.

The fears concerning intellectual freedom which Prof. A. V. Hill expressed four years ago in his Huxley Memorial Lecture on "The International Status and Obligations of Science", have indeed been justified, and it cannot be said that scientific workers as a whole have heeded his warning. Many of them still forget that freedom of thought, though fairly and hardly won, is not a permanent and inevitable attribute of science, but has to be maintained by further struggle. The coercion of scientific workers to specified political opinions has already lowered the standard of scientific honesty in those countries and if unchecked may bring science itself into contempt. Nor would it be hard to find evidence of forces in the Anglo-Saxon communities which are working to hinder research, to destroy free thought and to strike at the root of all opinion not congenial to authority.

This, therefore, is no time for shallow complacency, for self-congratulation at the comparative freedom of thought to be found in one country rather than in another. Scientific workers cannot be content to concern themselves solely with the advance of a science within their own national frontiers. That way lies impoverishment and ultimate stultification. The advancement of science no less than the continual progress of mankind demands that the liberty lost anywhere shall be regained. Science and learning must recognize that they exist not only for their own sake, not only for what they can do for the material welfare of mankind, but chiefly for the fact that they alone seem to be truly international and capable of transcending national follies.

Among the welcome signs that scientific workers are coming to recognize the gravity of the situation are the resolutions passed at the Indianopolis meeting of the American Association for the Advancement of Science, and the response they have already received. The first resolution, affirming the independence of science of national boundaries and races and creeds, and asserting that science could only flourish where peace and intellectual freedom were found, extended an invitation to the British Association for the Advancement of Science to co-operate not only in advancing the interests of science but also in promoting peace among nations and intellectual freedom. The same resolution also declared that an examination of the profound effects of science upon society was one of the objectives of the Association.

The second resolution referred even more specifically to the inroads being made upon intellectual freedom, and declared emphatically that if the existing liberties, won through ages of struggle and at enormous cost, were lost or seriously impaired, there could be no hope of continued progress in science or even of lasting material welfare. The suppression of independent thought and its free expression was denounced as a major crime against civilization, and the executive secretary of the Association was requested to raise with the British Association the question of co-operation so that the combined scientific forces of America and Great Britain should act as a united world intellect.

From these resolutions there have already been derived a number of concrete proposals, such as the formulation of a set of fundamental scientific principles of an ethical nature, and of the maximum number of inviolable methods of international intercourse and co-operation among scientific workers, as well as the planning of machinery for giving effect to such proposals. Progress in such matters, however, is determined largely by the extent to which individual scientific workers are prepared to contribute both interest and active support. Upon them depends mainly whether or not such matters figure prominently or not at all in the proceedings of the forthcoming meeting of the British Association.

If the present drift is to be arrested, and science and learning are to regain everywhere the immunity from interference or persecution to which they have been regarded as entitled in all civilized communities for several centuries, it will not be by the efforts of a minority of scientific workers. Science will only be re-established in its unique place among the interests of mankind when

scientific workers everywhere recognize their responsibilities and are prepared to make fresh sacrifices in the cause of intellectual freedom. They must educate their fellow citizens to the realization that science is a common interest of mankind, and that whatever may be the barriers or the difficulties or the struggles between them, civilized societies must accord a certain immunity and tolerance to those engaged in scientific discovery and learning.

Besides this, there must be a widespread recognition by scientific workers of the normal conditions of tolerance and immunity for scientific pursuits in a civilized State. These restraints—not to meddle with or be dominated by divinity, morals, politics or rhetoric must be clearly understood and firmly accepted by scientific workers. The loyal acceptance of such a code of ethics or discipline is all the more important to-day, not only if objective research in the social sciences is to be pursued, but also if what is often termed the frustration of science is to be overcome. Scientific thought can no more exert its full weight than objective research be pursued unless scientific workers maintain most scrupulously their intellectual honesty and independence of political pressure. The discipline of professional ethical codes, no less than the intellectual or technical excellence of the work carried out, is an important factor in establishing confidence in the integrity and impartiality of the results obtained.

Scientific workers cannot afford to be indifferent to these matters. They should be willing to make the effort both as men of science and as citizens, and to accept the challenge now thrown down to them. Unity in defence of full freedom of thought, formulation and acceptance for themselves of the inevitable restraints demanded in a civilized community for orderly progress, refusal to allow any external system of thought or institution to dictate their decisions or activities, and promotion by all means in their power of the international exchange of ideas and its accompanying stimulation of thought are some of the necessary steps. Given these desiderata, it will not be long before fresh victories are won for intellectual freedom, before the restraints on scientific intercourse are broken down and science is able to assist all nations to deal creatively and constructively with the great problems which everywhere confront us to-day.

A Chapter in the History of British Botany

Sixty Years of Botany in Britain (1875-1935): Impressions of an Eye-Witness. By Prof. F. O. Bower. Pp. ix + 112 + 14 plates. (London: Macmillan and Co., Ltd., 1938.) 10*s*. 6*d*. net.

ALL Prof. Bower's books have been characterized not only by their clearness of style but also by a power of transmitting to the reader the interest of the writer. This sense of the enjoyment which the author has experienced in the writing is specially evident in the present book, which gives in vivid outline the history of an important phase in the development of botany in Great Britain. In the period of which it treats, an almost revolutionary change was effected from the preceding purely systematic work to the aspects of botany familiar in our modern universities. It was well worth while having the facts recorded, but this book is much more than a historical statement. The history is strung on an equally interesting thread of autobiography, for Prof. Bower not only lived through the whole period of which he writes, but also took an active part in its events. As the sub-title indicates, we are throughout receiving the impressions of an eye-witness. Thus the reader is led on with sustained interest, grateful for the first-hand pictures he obtains of personalities and their work and sometimes a little regretful that he does not get more. This artistic reserve, together with the clarity of the writing, makes the reading of the book not only profitable but also a real pleasure.

As a boy at home and at a public school, the author was interested in natural history and especially in botany. When he passed hopefully in 1874 into the University of Cambridge, he found the science almost dead, although the beginning of a revival was evident before 1879 in the private teaching of Vines. It was from the active botanical schools of the Continent that the new botany came belatedly to Britain and, like others who were concerned in its introduction, Bower went abroad to work in the laboratories of Sachs and De Bary. Reform in university teaching of the subject, on the other hand, came through Huxley at South Kensington, and Prof. Bower gives us glimpses of the life of a young botanist in London in 1880–85. He became responsible for the botanical

classes instituted by Thiselton-Dyer in Huxley's department, and there was active research work in the recently established Jodrell Laboratory in Kew Gardens. In 1885 Bower was almost commanded by Sir Joseph Hooker to take on the duties of the regius chair of botany at Glasgow, which he held for forty years. Botany was by then established on the new lines in England, but the work was still in great part to be done in the Scottish universities. The progress of the department at Glasgow is a good illustration of what took place in other universities.

In the course of the historical account, we have estimates of many great figures; of Hooker, Sachs, De Bary and Huxley among the seniors, and then of the younger men chiefly concerned in the movement. The brief accounts are accompanied by good portraits. It will be a revelation to many how much vital stimulus botany owed to men of whom one tends to think chiefly as administrators. This is particularly true of Thiselton-Dyer's part in the movement, but also holds for Vines and Balfour. The story of the foundation of the *Annals of Botany* by the latter is told in full. In connexion with the progress of fossil botany, we have personal impressions of Williamson, Scott and Kidston. This subject is taken as one illustration of the progress of branches of botany in Britain. It is balanced by a short consideration of the emergence of pure physiology in the botanical departments of the country, headed by Cambridge, where Francis Darwin and Gardiner were the initiators. Space will not allow of adequate comment on a chapter entitled "The Morphological Kaleidoscope", which, as the author points out, is written in somewhat more technical style than the rest of the book. Here also the changes in point of view, the discoveries which "jogged the morphological kaleidoscope" and brought out new patterns in the study of the evolutionary morphology of land-plants, are made significant by being taken from Bower's own scientific experience.

A concluding chapter sums up the story sketched in the book; estimates the present state of botany in Great Britain, frankly recognizing the decline of interest in morphology; and looks with breadth of view and hopefulness to future progress both in pure botany and in its practical applications.

Prof. Bower has given us a valuable book which may interest many in addition to professional botanists. It should be available for the students in every botanical department. In proportion to their youth, readers will be removed from any personal contacts with the small body of pioneers who laid the foundation of the differentiated, perhaps over-specialized, science as it is now found in our universities. Prof. Bower has been able to write as an eye-witness of these men and their work and has done this so vividly that we can realize how the botanical departments in which we work and the conditions we take for granted have come about. This is the book's immediate value; but the data it contains may prove invaluable to some future botanical historian. Those who introduced what was then called the 'new botany' were united in enthusiasm and in a sense of adventure, the thrill of which persists in these pages. What may be read between the lines, but is worth while making explicit, is the great part played by Prof. Bower himself, not only in the early stages of the movement, but also in carrying its spirit on to a later period. The reviewer can speak gratefully of the stimulating atmosphere which radiated from the professor in the still primitive department at Glasgow in the early 'nineties. As he can now realize, this was the direct outcome of the new spirit in investigation and teaching which came into botany in Great Britain in the 'seventies, and the history of which is the theme of this book. W. H. L.

Research in the Antarctic

South Latitude

By F. D. Ommanney. Pp. xi + 308 + 16 plates. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1938.) 9*s*. 6*d*. net.

EVER since Dr. Stanley Kemp, as director of research to the Discovery Committee, began in 1924 to get his staff together, the Natural History Museum at South Kensington has seen the coming and going of a group of young scientific men, for the most part biologists, collected from the universities of England, Scotland, Wales and Ireland. They would spend a few months at the Museum and then disappear for a year or two, to return, looking somewhat weather-beaten, accompanied by piles of packing-cases and casks (not always odourless) to arrange and study their collections in an iron shed at the back of the Museum, and to produce the long series of "Discovery Reports" which have been noticed from time to time in the pages of NATURE. Thanks to these reports, the Antarctic Ocean is becoming the

best-known, from a scientific point of view, of all the Seven Seas. About their work these young men were always ready to talk to us, about the Antarctic Convergence, or the corpora lutea of whales, or the migrations of krill, but of their personal experiences we could hear but little. Yet, sometimes, over a pipe, one did get the impression that scientific research in the Antarctic was a man's job. Now, however, they have found a worthy spokesman.

Dr. Ommanney has the gift of arresting and vivid description; he has looked upon men and beasts and things with an observant and sympathetic eye; and he has the sense of humour to perceive the ridiculous in himself as well as in his companions. He does not dwell too long or too exclusively on the discomforts and hardships, but he does make us feel in some measure what it meant to step from teaching biology to first-year medical students to the gigantic horrors of flensing. Some of his pages are not for the squeamish, but if he is a realist, he is not of the type that is blind to the beauty beside the ugliness in Nature or to the nobility that lies behind the meanness in the spirit of man. Ommanney was one of the survey party of six men who were lost for ten days on King George Island in the South Shetlands, and tragedy was only missed by a hair's breadth. The story of their experiences is as moving as anything that has been told us from the Antarctic, and none the less so because they were not out to make a sporting 'record' but were doing a bit of sober and humdrum scientific research.

Although this book touches only incidentally on the scientific work that the author and his colleagues were doing, it does preserve many details that may be missed in more formal reports. The choking stench and deafening clamour of the penguin rookeries, the loathsome slumbers of the sea-elephants on the beaches, the dignified albatrosses on their nests—the ecologist must not forget these in his picture of antarctic life, while the student of animal behaviour will note the apparent inability of seals and penguins to concentrate attention for more than a few moments on anything lying outside the daily routine of their lives. It may be true that "the elephant never forgets", but the sea-elephant seems unable to remember for five minutes that he has watched one of his companions being butchered within a few yards of him.

The Colonial Office has at its disposal to-day not only the finest ship ever built for oceanographical research, but also a team of some of the most experienced oceanographers in the world; just how experienced, Ommanney has made clear to us in this book. It is much to be hoped that good use will be found for both when the present programme of research is brought to an end.

Psychiatry from the Behaviourist Point of View

A Biological Approach to the Problem of Abnormal Behavior

By Dr. Milton Harrington. Pp. 459. (Lancaster, Pa.: The Science Press Printing Co., 1938.) n.p.

THE disadvantages of the psychological approach to mental illness, the difficulty in proving facts, the prolonged treatment during which the patient is under the influence of the physician and the unpalatable theories of the psycho-analysts, have driven many to seek a basis for psychiatry elsewhere. It is inevitable that those who turn away from psychological theories should return to the obviously firm facts of physiology, and to such the investigations of Pavlov and the behaviourists are a gift from the gods.

Dr. Milton Harrington has already written a book in which he criticized the structure and theory of psycho-analysis ("Wish-hunting in the Unconscious", Macmillan, 1934) and in his present book we have the second of a triology. Here his efforts have "not been to present new evidence bearing on the problem of abnormal behaviour, but to bring together into the form of a theory, the important facts at present known to us, thus consolidating the gains already made and preparing the way for further progress". (The third book which will complete his triology is to be on treatment.)

It is obvious that with such an intention nothing new or strange will be found in his book. Moreover, the author does not take an entirely behaviourist point of view, but is willing to recognize consciousness and to use what he thinks is good in the old psychology. He thus obtains the best of both possible worlds, and by utilizing familiar physiological and psychological facts, he describes a psychophysiology upon which he constructs his psychopathology. Two thirds of the book are devoted to the psychophysiology and a third to the psychopathology. It is described in an interesting way with a facile style, and the whole is logically developed. One feels, however, a certain poverty

of material, and, indeed, the behaviourist's explanations are so obvious that any attempt to expand them makes a book rather laboured. Dr. Harrington makes the most of his material, and his description of the 'Law of Confluence', by which it is possible to explain conditioning, reinforcement, inhibition, and the production of symptoms, all by one principle, is most interesting and valuable.

When we come to the psychopathology, we cannot help feeling unsatisfied. Nor does it offer, as all pathology should, any fresh basis upon which to construct treatment. It is doubtful whether we can explain, for example, the appearance of claustrophobia simply by conditioning. The claustrophobic seldom give a history of repeatedly being shut in closed spaces, and even if one or two terrifying instances will suffice to condition the child (as recent work suggests), the innumerable instances of harmless enclosure in daily life should neutralize them. In fact one can scarcely live without going into lifts and so on, every day, and yet someone who has done this without difficulty for years may suddenly become frightened of them. The author's explanations of paranoid delusions given on page 422 are not very satisfactory and merely echo the old traditional views. If delusions could arise so easily they would be a great deal more common than they are to-day.

In spite of these criticisms, the book is sound and no one can do other than profit from reading it. There are very few mistakes—the most obvious is on page 343, where the writer mentions "an innate sense of modesty", and one wonders if he really believes that modesty is inborn and not acquired.

Dr. Harrington is to be congratulated on attempting to found a behaviourist psychiatry, and if it is far from complete it is because he is bound by limitations of his own seeking. No doubt he feels it is better to build a small safe structure than a towering construction of doubtful theory.

CLIFFORD ALLEN.

The Universities Yearbook

The Yearbook of the Universities of the Empire, 1938

Pp. xlv + 1154. (London: G. Bell and Sons, Ltd., 1938.) 15*s*. net.

THE first Congress of the Universities of the British Empire, held in London in 1912, resolved that the time had come for establishing a permanent centre of information to carry on the good work begun by the Congress of weaving a fabric of mutual knowledge and understanding. Thus originated the Universities Bureau of the British Empire and the Yearbook, the compilation of which is one of its most important tasks. In addition to being a who's-who and a what's-what for the universities, a shop-window for the wares they have to offer and a summary record of their annals, it brings together in a series of appendixes a heterogeneous mass of data relevant to the interests of their members, actual and prospective.

Such a compendium has a tendency to become unwieldy, and this year the appendixes, now covering 240 pages, have been rearranged in a more logical sequence than heretofore, facilitating quick reference. They deal with such matters as: admission to universities, students from abroad, open post-graduate scholarships, admission to professional careers, associations of students, of teachers and of other people interested in higher education and research, centres of scientific research and information, libraries, universities of the United States, Anglo-American professorships, international organizations.

Lastly, there is a bibliography, admission to which is jealously restricted. Perhaps a little more latitude might be allowed for new publications, for as long as they are new: for example, the publications of the International Institute Examinations Enquiry Committee (only one of which is mentioned), the N.U.S. congress report entitled "Graduate Employment" and Prof. Ginsberg's address to the British Association last year.

In this year's issue appears, for the first time, the annual report of the executive council of the Universities Bureau. The publicity thus given to the Bureau's proceedings is doubly acceptable by reason of the fact that the report includes a summary of the proceedings of the Committee of Vice-Chancellors and Principals of the Universities of Great Britain and Ireland, lineal descendant of the committee constituted twenty years ago in response to Lord Balfour's appeal to the universities to establish a body which should not only represent them vis-à-vis the Government and in their relations with the universities of other nations, but also should be an "organ of expression" to voice their desires and aspirations. The list of subjects discussed by the Committee (p. xxxi, and again on pp. 17–18) is a long one, most of the items being of minor importance. It does not appear whether any of them were matters referred to the Committee by Government departments, as contemplated in Lord Balfour's appeal.

Contemporary Indian Philosophy

By M. K. Gandhi, Rabindranath Tagore, Swâmi Abhedânanda, K. C. Bhattacharyya, G. C. Chatterji, Ananda K. Coomaraswamy, Bhagavan Das, Surendranath Dasgupta, Hiralal Haldar, M. Hiriyanna, S. Radhakrishnan, R. D. Ranade, V. Subrahmanya Iyer, A. R. Wadia. Edited by Dr. S. Radhakrishnan and Prof. J. H. Muirhead. (Library of Philosophy.) Pp. 375. (London: George Allen and Unwin, Ltd., 1936.) 16*s*. net.

IT is for the mutual benefit of Eastern and Western philosophers that such books as the present are published. A clarification of Indian thought is just as important to Indians themselves as to the growing number of European scholars who make a technical study of Indian thought. Of the fourteen thinkers who contributed to the present volume, Gandhi and Tagore belong to Indian national life, and their messages are incorporated more for their moral influence than for their expert value. But the essays of the other writers provide much food for reflection.

Meditating "On the Pertinence of Philosophy", Dr. Coomaraswamy suggests that the highest wisdom is obtainable by finding what is common to different religions and by constructing a rational metaphysics on these common elements. An example of the method proposed is given in a comparative study of the idea of immortality. Discussing "The Spirit in Man", Sir S. Radhakrishnan reconciles theism and absolutism. But both are rejected by Prof. Wadia, as giving no explanation of evil, in favour of pragmatic idealism. The suggestive study of Prof. Dasgupta on "The Philosophy of Dependent Emergence" and Prof. Hiriyanna's essay on "The Problem of Truth" will be read with much interest, while Prof. Ranade's contribution, in which he proposes to reach truth by a critical interpretation of the great philosophers, is perhaps the most original of the series. An excellent study of Vedantic philosophy is given by Subrahmanya Iyer, who discusses *maya* (illusion) and the three states of the soul (waking, dreaming and sleeping).

On the whole, the essays contained in this book deal mainly with personal philosophy and religious problems; and they show, with the exception of those of Prof. Dasgupta and Prof. Chatterji, that absolutism is in great favour in contemporary Indian thought. This is an indication of the strong influence of religion on philosophy, which will continue to be an outstanding characteristic of the Hindu mind.

T. G.

The Structure and Development of the Fungi

By Dame H. C. I. Gwynne-Vaughan and Dr. B. Barnes. Second edition. Pp. xvi+449. (Cambridge: At the University Press, 1937.) 18*s*. net.

TEACHERS and students of botany and mycology will warmly welcome the second edition of this well-known book. During the decade which has elapsed since the book was first published, research on the fungi has been ardently pursued; much additional knowledge has therefore been incorporated in the present edition, illustrated by figures of the same excellence as characterized the book originally. Among many new features one is glad to see the inclusion of a section on the interesting group of the Blastocladiales, an account of the recently discovered function of the spermatia of the rusts, and a much fuller discussion of the phenomena of heterothallism and variation in the fungi than was possible in 1927. Some new methods are described in the chapter on technique, and the references to literature have, in general, been brought up to date.

As indicated by the title, the book deals primarily with the morphology of the fungi, and only in a subsidiary manner is their mode of life discussed. In a few instances reference to the latter has not incorporated recent work: for example, some authorities consider that the primary cause of larch canker is frost and not *Dasyscypha Willkommii*, and fresh light has been thrown on the parasitism of *Epichloe typhina* and *Armillaria mellea*. It is now scarcely true to say that the Ustilaginales are obligate parasites, for several species have been cultivated on artificial media. *Ustilago Carbo*, treated as a single species, is really a complex of species with diverse life-histories. These, however, are but minor imperfections in a book of generally supreme excellence. In fact, the authors have described the structure and development of the fungi so well that an urgent appeal can be made to them either to include a fuller account of the general biology of these organisms in the next edition or to write a companion volume on this theme.

Physik für Studierende an Technischen Hochschulen und Universitäten

Von Dr. Paul Wessel. Herausgegeben von Dr. V. Riederer von Paar. Pp. xii + 550. (München: Ernst Reinhardt, 1938.) 4·90 gold marks.

THIS text-book of physics for engineers and technical college students is a kind of pocket-edition of an intermediate course in physics with certain elaborations and unusual features. While the fundamentals are surveyed, in an effective and extremely compact manner, in two main divisions of the work extending over some 350 pages in which special reference is made to X-rays and crystal structure and to atomic physics, the whole of the foregoing material is later re-surveyed in a more condensed fashion as a revision course occupying some 50 pages. This is followed by another 50 pages containing a series of questions and answers, the latter usually taking the form of a reference to the appropriate page on which the relevant information necessary for a correct answer is to be found. Finally are given a goodly collection of mathematical and physical tables, where, in addition to much useful data normally required by engineers and physicists and to be expected in a book of this nature, are given tables such as those of the isotopes of xenon, the families of radioactive elements and the wave-lengths of the *K* series of the X-ray spectra of various elements, the usefulness of which is not obvious.

The work is well illustrated and indexed, and should be most helpful to English-speaking students who wish to acquire a knowledge of scientific German.

L. F. B.

A Monograph on Veins

By Kenneth J. Franklin. Pp. xxii+410. London: Baillière, Tindall and Cox, 1937.) 27*s*.

IF anyone supposes that little is known about veins his opinion will be altered when he reads this scholarly, but interesting, monograph, which covers the whole literature from the sixth century B.C. to 1936 from the points of view of the anatomist, embryologist, pharmacologist, histologist, clinician, historian and photographer—in fact from the point of view of the physiologist.

Veins have been Dr. Franklin's principal interest since 1924 and he has published many papers describing skilful work carried out with careful accuracy. Fleisch and Gollwitzer-Meier have simultaneously concentrated on the same problem. Few people have known enough about veins to appreciate the significance of this work, but Dr. Franklin has now fitted the pieces together. He was himself surprised at how well they fitted and many of his readers will share his emotion. It must not be imagined, however, that the picture is complete, for many fundamental problems are still a matter of controversy. For example, John Hunter suggested that the pulsations in arteries acted on veins like the movements of a piston in a pump, forcing the blood past the valves. This theory has been accepted by some and rejected by others, but the propulsive effect has never been demonstrated, though compression of veins by the pulse has been observed by X-rays in men and dogs.

The subjects discussed include the blood depots, the peculiar vascular anatomy of diving animals, the effects of muscular contraction and respiration on the venous return, the pharmacological and nervous control of veins, venous pressure, arterio-venous anastomoses, varicose veins and the history of intravenous injections and venesection.

The book is attractively produced with excellent photographs, diagrams and historical portraits. About 1,200 references are given in the bibliography.

J. H. G.

The Annual Register:

a Review of Public Events at Home and Abroad for the Year 1937. New Series. Edited by Dr. M. Epstein. Pp. xiv+488. (London: Longmans, Green and Co., Ltd., 1938.) 30*s*. net.

WITH unfailing punctuality this concise review of world history and achievement makes its appearance. A calm review of the stormy year of 1937 can have been no easy task, but it has been achieved without bias yet with enough spirit and vivacity to make it readable from beginning to end. As usual, British and foreign history each occupy about one third of the book. Particular praise may be given to the survey of internal affairs in Great Britain and to the accounts of Germany and the Soviet Union. Spain, China, Japan and the United States also occupy many pages. The writer of the survey of the literature of the year comments on the deterioration in standards of human justice and the discouragement of free speech which he believes have tended to slacken creative effort. Unfortunately it is impossible to deny this belief. The survey of science, however, records advances in several directions although the condensation of the account, no doubt on the grounds of space, is almost excessive. There are also the usual surveys of art, drama, law and finance. Among the public documents printed in full are the Constitution of Ireland and the United States Neutrality Act. The obituaries of the year give admirable biographies of eminent men and women of all countries.

Théorie Cinétique des Liquids

1. Fluctuations en Densité. 2. La propagation et la Diffusion de la Lumière. Par Prof. J. Yvon. (Actualités scientifique et industrielles, Nos. 542 and 543.) Pp. 133, together. 18 francs each.

THE author develops a theory of the propagation and diffusion of plane polarized light without change of wave-length by a monatomic liquid, for example, argon, the molecules of which are assumed to be spherical and isotropic. The first part deals with the density distribution and the effect on it of gravity and thermal agitation, the second with the dielectric constant, refractive index and diffusion of such a liquid, the statistical method of Gibbs being used throughout. An expression for the ratio of the strength of the source of diffused light furnished by a volume of the liquid per unit intensity of the incident light (Rayleigh's ratio) is obtained which agrees satisfactorily with experimental results for benzene but not for water. As neither is monatomic, observations on monatomic liquids are required before attempts are made to extend the theory to complex molecules. Each part contains nearly 100 references.

The Statesman's Year-Book:

Statistical and Historical Annual of the States of the World for the Year 1938. Edited by Dr. M. Epstein. Seventy-fifth Annual Publication, revised after Official Returns. Pp. xxvi+1497. (London: Macmillan and Co., Ltd., 1938.) 20*s*. net.

THIS annual has effected a significant change this year. The first part of the book is no longer entitled "The British Empire" but has become "The British Commonwealth of Nations". Within this embracing title comes first of all the British Empire, including Great Britain and Northern Ireland, the Colonies, Protectorates, India and Burma, and secondly the Dominions, concluding with Ireland. The remaining sections of the book have undergone no change in arrangement but the usual careful revision in detail. Abyssinia and Austria linger in their alphabetical places, but all effective and other changes in their Governments are noted. The section on the States of Germany has disappeared. As usual, corrections and additions are made up to the end of March or even later. Of the two coloured maps, one illustrates the strategic position of Singapore and the second shows the distribution of steel production and associated ores, iron, manganese chromite, etc., throughout the world.

James Gregory (1638-1675)*

By Prof. H. W. Turnbull, F.R.S.

IN the early seventeenth century, two brothers, Alexander and David Anderson of Aberdeen, rose to mathematical distinction. Alexander, who went to Paris as professor of mathematics, became the friend and expositor of Vieta, while David, commonly called 'Davie-do-a'-thing', became the Archimedes of Aberdeen, constructed the spire of St. Nicholas Church, and removed 'Knock Maitland', a dangerous submerged rock, from the harbour by harnessing it to the tide. His daughter Janet married the Rev. John Gregory, of Drumoak on Deeside, twelve miles from Aberdeen, and thereafter for two hundred years their descendants occupied the chairs of either mathematics, medicine or philosophy in an unbroken sequence at Scottish universities, always with vitality and distinction.

The greatest of this remarkable family was James, the third son of John and Janet Gregory, who gained renown for the invention of the reflecting telescope, but was also a mathematician whose genius is outstanding even among the giants of the age of Newton. James was born in 1638, the year when Descartes gave analytical geometry to the world and Galileo his laws of motion; he died prematurely in 1675, of a sudden illness accompanied by blindness which befell him as he was observing the planet Jupiter in company with his students at Edinburgh. He received his first lessons in mathematics from his mother; he eagerly mastered Euclid's "Elements" given to him by his elder brother David at the age of thirteen or fourteen; he went to the Grammar School and later to Marischal College at Aberdeen, where he graduated.

By the age of twenty-four years, James Gregory had written his "Optica Promota", which contains an elegant and geometrically accurate account of mirrors and lenses, beginning with the re-discovery of the sine law (of Snellius and Descartes), dealing with elliptical and hyperbolic surfaces and ending with a description of a reflecting telescope. An astronomical appendix also suggests the importance of observing the transits of Venus and Mercury for calculating parallax. In 1663, Gregory went to London and the book was published. He met Collins and Hooke, who put him in touch with the celebrated optician Reive; Reive tried to make such a telescope, but the resulting mirrors were a failure and the attempt was abandoned. But Hooke, that prince of experimenters, persevered, and in February 1674 presented the first Gregorian telescope to the Royal Society, and the same form was universally employed in the eighteenth century.

Gregory spent the next three years in Italy, chiefly at Padua, where the great Galileo had taught. There Gregory printed, in 1667, his "Vera Circuli et Hyperbolæ Quadratura", wherein he showed how to find the area of the sector of a conic by means of convergent polygons, and actually attempted to prove the transcendence of the ratios nowadays denoted by π and e. (He considered π and also the number 2·3025850929940456 . . . which is $\log_e 10$; this he calculated correctly to seventeen figures.) The book lays the foundations of hyperbolic sines and cosines, as well as the concepts of convergence and algebraic invariance under transformations.

In 1668, Gregory returned to England with a third book, the "Geometriæ Pars Universalis", which gives a systematic *geometrical* account of the calculus, based on the work of Cavalieri and Fermat. It contains the earliest proof of the fundamental theorem—that the method of tangents (differentiation) and of quadratures (integration) are converses of each other. It also shows how to transform $\int y dx$ to $\int z dy$, where $z dy/dx = y$. This book profoundly influenced Barrow, who published his "Geometriæ Lectiones" in 1670.

Gregory remained in London until the autumn of 1668 with Collins, who egged him on to solve the unproved theorems of the day. As a result he produced a booklet, the "Exercitationes", containing a remarkable method of reversing a power series $f(x)$ in the form $x = \Sigma c_n f(x/2_n)$, together with rigid proof of Mercator's theorem on the expansion of $\log(1+x)$. By integrating $\sec x$ and $\tan x$ Gregory cleared up the mystery of the rumb spiral, explaining why Wright's "Nautical Tables" of 1599 actually presented a set of logarithms, of which the author was unaware.

In 1668 Gregory was appointed first professor of mathematics in St. Andrews, where he resided until 1674. Partly owing to a conflict with Huygens over the "Vera Quadratura" and partly through hearing of Newton's success in the "Analytics", Gregory never again published his mathematical work, beyond adding one short note to a vehement little book on the "New Art of Weighing Vanity", written by a colleague, William Sanders, a regent at St. Leonard's College, St. Andrews; this book was directed against George Sinclair, a

*Substance of a paper presented on Monday, July 4, 1938, at the Royal Society, Edinburgh, and also of an address on Tuesday, July 5, at the Tercentenary Graduation, University of St. Andrews.

retired professor of natural philosophy at Glasgow, who had quarrelled with Sanders. The note contains the expansion of an elliptic integral in a doubly infinite series and solves the finite motion of a circular pendulum. In 1674 Gregory was appointed to the chair of mathematics in Edinburgh, which he only held for a year before he died. He married in 1669 Mary, daughter of George Jamesone the painter, and widow of Peter Burnet, of Aberdeen, and they had two daughters and a son, James, afterwards professor of physic in King's College, Aberdeen (d. 1731).

A long correspondence (1668–1675) between Gregory and Collins has happily been preserved. Gregory's letters were printed in Rigaud's "Correspondence of Scientific Men of the 17th Century". Collins's letters, which are now in the University Library at St. Andrews, have never yet been published, but the present tercentenary year affords an appropriate opportunity for doing so, particularly as they contain—on the blank spaces of the letters—some fifty mathematical notes of James Gregory in his own hand, revealing either the methods employed in such results as he sent to Collins by letter, or in still newer work which never saw the light. Careful scrutiny, begun in 1932, has unravelled their contents, and shows that Gregory actually anticipated Taylor, by forty-five years, in his famous expansion theorem, that Gregory could integrate $\sin^n \theta$, and had gone deeply into the theory of rational right-angled triangles and Diophantine quadratic equations. It is now possible to judge how slight was his mathematical contact with Newton; also how Barrow and Gregory influenced one another. It is noteworthy that Gregory probably never even heard of the name of Leibniz. These discoveries among the old letters go far to explain the fact that in his day Gregory was held to be second only to Newton.

Vaccination of Cattle against Foot-and-Mouth Disease

THE devastating epizootic of foot-and-mouth disease which has raged over Western and Central Europe amongst cattle, sheep and pigs since last autumn has by no means come to an end, though there have been some signs of local or temporary abatement in those areas first invaded in Holland, Belgium and parts of France and Germany. Sweden, Norway and Denmark have suffered little, and are always ready to stop early invasion by slaughter. In Great Britain there have been exceptionally severe and numerous outbreaks, but the number of farms affected and of animals infected or lost by slaughter has not approached that of the Continental calamity. On June 1 last, the number of farms infected in Germany was officially reported as 42,306.

Persistent research work in Germany has been carried out for forty years almost continuously, and since the Great War by Waldmann on the island of Riems; in France much valuable work was also done by Vallée at Alfort. In Great Britain research has been in progress since 1924, but though knowledge of the disease has increased, it has only been possible to increase the means of control in special circumstances and to reduce the spread of infection. Experimental stations have also been set up in recent years in Holland and Denmark.

The chief aim of investigation has been to find a method of protective vaccination, and many attempts have been made to devise a safe vaccine made from the virus, attenuated by biological, chemical or physical treatment, or made safe by the manner of its administration.

Inactivation of the virus by formalin has until recently appeared to be the most hopeful method, and has perhaps never been tried in the field with sufficient care and persistence. During the last few years, a technique of adsorption of virus with aluminium hydroxide has been very carefully worked out with great detail by Schmidt and his colleagues in Denmark on guinea pigs, and very promising results have been published. He attached great importance to the administration of the adsorbate-vaccine subcutaneously, for by other routes it was capable of producing infection. The results of vaccination given by Schmidt closely resemble those obtained with formalinized vaccine, but the adsorbate appears to be less safe and to give a somewhat higher degree of protection, as might be expected from a less completely inactivated virus. Waldmann maintains that Schmidt's vaccine is too dangerous, and he does not accept the suggestion that the active virus can only be released so slowly from the adsorbate as to be safe though still capable of giving active immunity.

A modification of Schmidt's vaccine has recently been used by Waldmann in Germany with additional safeguards to ensure its inability to produce the disease and spread infection. It was first tested on cattle at the Riems station with good results. The accessory chemical or physical means of attenuation devised by Waldmann have not yet been published, though an account of the vaccination of more than 40,000 cattle with this preparation has appeared in the *Berliner tierärztlicher Wochenschrift*, Nos. 22 and 24 (1938).

The initial difficulty in vaccination so as to prevent an invasion of the disease has always been that the vaccine must be prepared from active virus, and only relatively small quantities of virus can be obtained from one infected cow.

The immense number of infected animals in Germany at the present time, and the high degree of organization in the collection of material in outbreaks in separated districts, and in the preparation of the vaccine from the virus, have enabled this relatively large trial to be made in that country. The hope expressed that it will be possible to cultivate *in vitro* large quantities of suitable virus has so far not been realized. The results of the campaign reported from the areas dealt with appear to be good. Vaccine has been given to more than 40,000 cattle with apparently no spread of infection from the vaccinated animals. It is claimed that almost 100 per cent of the vaccinated animals have developed immunity within fourteen days and some degree of resistance in five days. There is also some evidence that the immunity lasted two to three months at least. Sheep, goats and pigs were not vaccinated as they were considered much less susceptible than cattle, and few outbreaks in these animals are mentioned in the areas where cattle were vaccinated. Three different groups of animals were vaccinated:

The first group of 9,582 normal cattle were in an uninfected district and were isolated for ten days to test the inability of the vaccine to infect normal cattle. The cattle were in thirty-three villages (950 farms) and were vaccinated between March 8 and April 9. No instances of the vaccine producing the disease were observed; only six cases of infection occurred, and there appeared to be good reason to attribute these to other sources. The animals also presumably developed a good immunity, as they remained free from the disease in the neighbourhood of an advancing epizootic.

The second group consisted of 19,486 normal cattle in districts where already a single outbreak had occurred; in this group, though a number of infections occurred in the first fortnight after vaccination, fresh cases then ceased and the animals appeared to have become immune.

The third group of 11,608 cattle was in districts where several outbreaks had already occurred and many of the animals had received an anti-serum. The number of cases after vaccination here was large, but fresh cases did not appear after the twelfth to fourteenth day, and this immunity was attributed to the vaccine. The districts for vaccination were selected because they were in the line of advance of the epizootic. It is stated that even eight days after vaccination the cases of disease appearing were fewer and less severe, and after fourteen days the immunity was almost complete.

In this field experiment there were no exact 'controls', and the course which the epizootic would have taken in the absence of vaccination could be inferred only from the events in the early days after vaccination and records of its course in other unvaccinated farms; the latter details are not included in the published account. It is possible that the synchronous and parallel outbreaks in other herds afforded sufficient 'controls', but the evidence has not appeared.

The Scophony Television Receiver

By H. W. Lee, Scophony Laboratories

THE Scophony television receiver is an optico-mechanical system and possesses the advantages over the purely electric systems employing a cathode ray tube that (1) larger pictures are possible without great expense; (2) high voltages are not necessary—the voltage of a radio set is sufficient; (3) there is lower power consumption for a given picture size. It is scarcely necessary to add that the Scophony receiver works on the B.B.C. transmission.

The essential parts of an optico-mechanical television receiver are: (1) optical elements for producing an illuminated area on the screen; (2) means for moving the illuminated area over the screen; this is at present done by giving it two components of uniform motion in two directions at right angles, one horizontally and one vertically; (3) means for modulating the intensity of the illumination in accordance with that of corresponding areas of the picture to be reproduced. The modulated signals are received in the form of electro-magnetic waves and are converted into variations in voltage in an electrically tuned circuit; these have to be converted into variations in light intensity. The difficulty of this conversion arises from the high frequency of the signals, which is 5×10^6. (The picture is divided up into approximately 500×400 elements and scanned 25 times a second.) In sound recording, the highest frequency

is of the order of 10^4; television has then an increase of 500 times. It is thus easily understandable that mechanical light valves are out of the question, nor is it possible to apply the electrical variations directly to a lighting circuit, because a sufficiently brilliant source cannot be extinguished from its condition of maximum illumination in one five millionth of a second. The Kerr effect was formerly employed, and is still used in the telegraphic transmission of pictures, but the light flux that the Kerr cell can handle is too small for high definition television. (It has other disadvantages such as high capacity, causing time lag.)

The Scophony Light Control, invented by J. H. Jeffree[1], employs a cell which may be 10 cm. × 2 cm. in area and allowing ample light flux; its action is based on the diffraction of light by compressional waves generated in liquid which act as a grating. Electrodes connected to the electric circuit excited by the radio waves are attached to a quartz plate of which the thickness is such that the natural period of vibration under electric oscillations is 10 megacycles. A parallel beam of light is sent through the cell and (in order to separate the diffracted from the undiffracted light) brought to a focus by means of a lens. An opaque shield cuts off the light of zero order (undiffracted light) and the diffracted light (three orders of spectrum are used) passes to the screen. The amplitude of the oscillation in the crystal, and of the compressional waves produced in the liquid at any time, is proportional to that of the electrical oscillations, which in turn is proportional to the light received at the instant from the element of the picture which is being scanned. As the supersonic wave travels along the cell, it is 'followed' by a rotating mirror of a mirror drum so that the small beam of diffracted light from it to the mirror is reflected in a fixed direction in space (compare the action of the heliostat mirror in following the sun's motion). A lens forms an image of the cell on the screen, so that the amount of light reaching a point on the screen is proportional to that of the corresponding point on the picture, but—and this explains the increased optical efficiency of this light control—the point is illuminated, not for one five millionth of a second but for the time the wave takes to travel along the cell. If we take the cell as 10 cm. long, this time, since the average speed of the waves at the frequency specified is about 1,000 m. per sec., amounts to one thousandth of a second—a 500-fold increase.

We have been considering the 'line scan'. The number of traverses the illuminated area makes per picture is called the number of lines (the B.B.C. standard is 405) and so the illuminated area, which in one direction may be equal to the width of the picture, must be limited in a perpendicular direction to a line width or 1/405 part of the picture height. This means that the image of the light cell on the screen must be compressed; to do this cylindrical lenses are required. Moreover, to reduce the length of the scanning drum so as to keep its inertia small, in order that the power required to drive and synchronize it may not be excessive, the light beam is still further compressed in this direction. This is the principal of the 'split focus' invented by G. W. Walton[2]; it is only by this reduction in size that it is possible to drive and synchronize the high-speed drum at 30,000 r.p.m. The drum is driven by an asynchronous motor and synchronized by means of a phonic wheel to which the synchronizing pulses of the transmission are applied. At the high speed used, glass would fly to pieces, so stainless steel is used, which metal is necessary in order to obtain optically polished mirror faces. The amount of steel is kept at a minimum, and the drum is in fact a steel annulus with an aluminium core. The inertia can thus be brought down to 137 gram. cm.^{2}. The slow-speed drum to provide the scanning in the other direction has to change the picture (or 'frame') 50 times a second and moves only 1/202·5 times as fast as the high-speed drum, for the same number of faces, and there does not arise the same need to reduce size.

Fig. 1 shows the lay-out of the system, but in order to show the optical arrangement, conventional sections made in two planes at right angles through the axis are shown (Fig. 2). Here the scanners are only indicated and for the sake of clearness the rays are shown undeviated by reflection at the scanners.

The lenses B_2 and C have a two-fold function. Inasmuch as C images the supersonic waves in the cell on to the screen, B_2 may be regarded as a field lens to C, reducing its size. On the other hand, the lenses B_2 and C have to form a well-defined image (of the light source) on the opaque shield, and furthermore they have to fulfil a condition which is peculiar to the Scophony optical system. A ray parallel to the axis impinging on the supersonic wave field at P at a distance h from the axis is brought to a focus at the shield at an angle θ to the axis. Now P travels with uniform linear speed along the cell, and the mirror drum rotates with uniform angular velocity; it is therefore seen that the condition h/θ = constant must be fulfilled[3]. (Compare the aplanatic or sine condition, $h/\sin\theta$ = constant.)

The above condition being satisfied, the following relationship must hold:

Equivalent focal length of B_2 and C is equal to the ratio of velocity of the supersonic waves to rotation speed of scanner. Putting the velocity of

the supersonic waves at 1,000 m./sec. $= 10^5$ cm./sec. and speed of rotation of drum at 500 r.p.m., we get equivalent focal length $= 50/\pi = 16$ cm. approximately. Now as there are 405 lines to the picture and 25 pictures per second (or 50 pictures of 202·5 lines in the interlaced system), there are 10,125 line changes per second. Therefore the supersonic waves must travel along the cell in 1/10,125 sec., so that the size of the cell is

$$\frac{100{,}000}{10{,}125} = 10 \text{ cm.}$$

approximately.

The aperture ratio of the two lenses B and C is therefore $\frac{10}{16}$ or 1/1·6.

For a cell 10 cm. long, holding 500 elements of the picture (an element being equal to the line width) each element occupies a space 0·02 cm. The wave-length of the supersonic waves is $\frac{10^5}{10^7}$ (frequency $= 10^7$) $= 10^{-2}$ cm., so that an element of the picture is carried by two complete waves. Nomoto has shown that a width of two waves produces the diffraction phenomena.

The equivalent focal length of B_2 and C being 16 cm. and the angle of diffraction being equal to (wave-length of light)/(wave-length of supersonic waves) $= 0{\cdot}55 \times 10^{-4}/10^{-2} = 0{\cdot}0055$ radians for light for which the eye has maximum sensitivity, the centre of the first order diffraction spectrum is displaced $16 \times 0{\cdot}0055 = 0{\cdot}09$ cm. from the axis; the centre of the second order diffraction spectrum is displaced $32 \times 0{\cdot}0055 = 0{\cdot}18$ cm. from the axis; and that of the third order spectrum $48 \times 0{\cdot}0055 = 0{\cdot}27$ cm. from the axis. It has been found experimentally that approximately 45 per cent of the light is diverted into the first order (at maximum modulation), 37 per cent into the second, and 8 per cent into the third (with negligible amounts in the higher orders, so that about 10 per cent is lost). Now the amount of light in the zero order is directly proportional to the area of the zero order, that is, the image of the light source formed by undiffracted light; but the amount of light in the diffracted spectra is not proportional to the area unless this is very small, because as the area is increased some of the diffracted light is cut off by the opaque shield, which must be equal in width to the zero order. It can be shown on the basis of the above measurements that the amount of light increases rapidly as the size of zero order is increased to 1·8 mm.

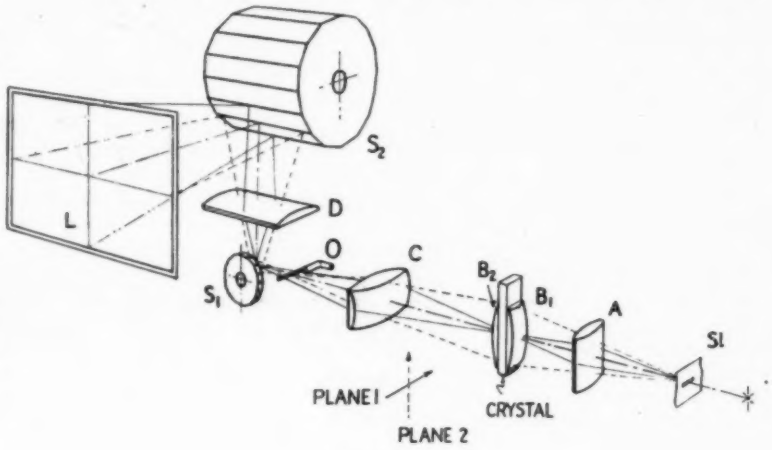


Fig. 1.

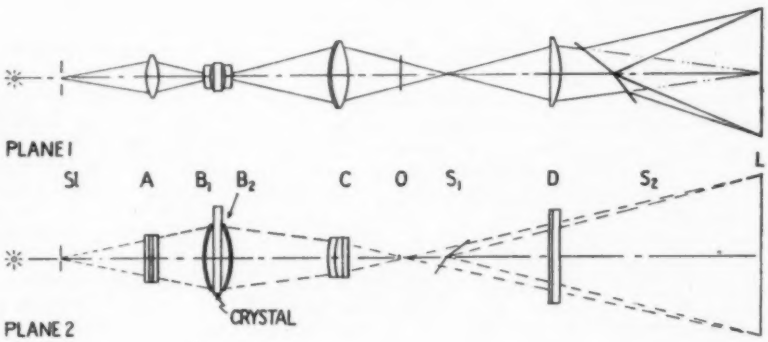


Fig. 2.

Sl IS AN ILLUMINATED SLIT.
A IS A CYLINDRICAL CONDENSER FOCUSING THE SLIT IN THE CELL IN PLANE 1.
B_1 COLLIMATES THE LIGHT FROM Sl, TO PASS THROUGH THE CELL AS A PARALLEL BEAM.
B_2 FOCUSES IT, WITH THE AID OF C, ON THE OPAQUE SHIELD O.
C FORMS AN IMAGE OF THE CELL ON THE SCREEN L IN PLANE 2 AND AN IMAGE OF THE LIGHT SOURCE ON THE SCANNER S_1 IN PLANE 1.
S_1 AND S_2 ARE THE TWO SCANNERS.
D FORMS THE 'LINE IMAGE'.

less rapidly for an increase to 2·6 mm. and thereafter very slowly. These calculations cannot be very accurate as no account is taken of light of different wave-lengths, but experiment is in agreement that a size of 2·5–3 mm. gives optimum results. It is preferable to interchange slit and shield, placing the shield in front of the light source and the slit in front of the scanner[4]; this arrangement gives a solid beam of light, instead of one having a hollow centre, taking up less room on the scanner. The diffracted light from this source can be dealt with very efficiently by a scanner of 5 cm. diameter.

A larger light source could be used by increasing the angle of diffraction by reducing the wave-length of the supersonic waves. To this there are several objections: shorter waves are more rapidly absorbed by the liquid (Nomoto states that no diffraction spectra can be obtained at frequencies of 30 megacycles, so that no great increase of frequency is possible); a larger light source would require a larger scanner, which would increase the difficulties of synchronization and driving; and finally, more power would be required to 'drive' the crystal (this is at present about 6 watts).

A rough idea of the accuracy required in the scanner can be obtained by considering that in the Scophony system a picture line of 500 elements is scanned by a rotation of 18° by the scanner. One element therefore corresponds to about 2 minutes of arc. Each surface of the scanner must therefore be placed accurately to a fraction of a minute of arc.

The present Scophony receivers, although operating by no means at the limit of optical efficiency, give the satisfactory screen brightness of 15 lux. The home receiver gives a picture 2 ft. wide, using a mercury vapour lamp. The public hall receiver gives a picture 6 ft. wide, using a standard cinema arc consuming 100 amperes.

[1] British Patent 439,236.
[2] British Patents 328,286 and 451,132.
[3] Patent applied for lenses fulfilling this condition.
[4] Patent applied for.

Obituary Notices

Prof. W. A. Bone, F.R.S.

THE death of Prof. William Arthur Bone on June 11 has removed from the field of fuel science one of its most prominent figures and distinguished research workers. So ended a career which has been remarkably effective in linking up achievements in the realm of theory with their applications to industrial progress over a long term of years.

Bone left the Friends' School at Ackworth and the Leys School, Cambridge, for chemical training at the University of Manchester at a time when a study of the properties of gases in explosion and combustion was already coming into prominence there, thanks very largely to the work of H. B. Dixon, and this course of training at home was supplemented by a period abroad with Victor Meyer. His promise as a student was indicated by the award of the Mercer Scholarship, Leblanc Medal and the Berkeley Fellowship at Manchester, and the Ph.D. at Heidelberg. In 1896, he became head of the Chemical Department at Battersea Polytechnic for two years, and then returned to Manchester as lecturer in fuel and metallurgy.

In the following years he began to make his mark as an investigator in the subject which, in one form or other, was to engage his attention during the whole of his working life. It was the work Bone did at that time which was largely responsible for a revision of the current ideas respecting the mechanism of the combustion of hydrocarbons and similar phenomena. The notion of the preferential combustion of carbon on one hand or hydrogen on the other in these compounds, which had been the subject of much discussion and many claims, gave place in the light of his researches to the more rational hydroxylation theory, in which the preliminary association of the oxygen with the hydrocarbon was not simply assumed to be probable, but demonstrated experimentally to occur. The successful outcome of this work was brought about by a combination of clear thinking and first-class experimental technique, which was to be a distinguishing mark of Bone's work throughout life as an investigator.

Meanwhile, at the sister University of Leeds, Prof. Arthur Smithells had also turned his attention to combustion phenomena and study of flame, and in 1907 he had so far impressed the Council at Leeds with the importance of fuel as a proper subject of university study, that the first chair in the subject was founded there, and Bone was invited to become its first occupant. During this time, Bone had been turning his attention to other phenomena of gaseous combustion which depended on the enormous influence exercised by hot solid surfaces on the rate of combustion of gaseous mixtures in contact with them. This 'surface-combustion' lent itself to striking experimental demonstrations and was made the subject of various industrial applications which, in one form or another, have been taking their place in gas-burning apparatus from that time onwards. The Bonecourt boiler is perhaps the best known example in which a very high rate of combustion and evaporation are obtained by burning a gas-air mixture in close contact with a solid packing of the boiler tubes.

In this part of his work Bone collaborated with McCourt and with the Leeds firm of Wilson and Mathieson.

In 1910 the association of the Fuel Department at the University of Leeds and the gas industry was cemented by the endowment of a chair of coal gas and fuel industries as a memorial to the recently deceased leader of the gas industry, Sir George Livesey, and Bone was made the first Livesey professor, a post which he occupied until 1912. As Livesey professor, apart from his more personal research work, he was occupied with that of a Joint Gas Heating Research Committee of the University of Leeds and the Institution of Gas Engineers, which carried out the first systematic investigation of the radiant efficiency of the gas fire. It may be mentioned here that Bone's interest in fuel matters had a wide range, and that partly no doubt on account of a family connexion with the iron works at Skinningrove, he was always specially interested in the fuel problems of the iron and steel industry. That was brought into prominence later in his life by an investigation which he carried out on the mechanism of iron ore reduction in the blast furnace, but as early as 1907 the same interest was manifested by the reading of a paper before the Iron and Steel Institute entitled "An Investigation on the Use of Steam in Gas Producer Practice". In this work, his collaborator was R. V. Wheeler, who later became professor of fuel at Sheffield, and it was carried out at the works of Messrs. Monks Hall and Company of Warrington. It was not original in the sense of disclosing any new chemical phenomena, but was a systematic and thorough examination of a prominent feature of gas producer practice on which very necessary information had been lacking, and its results have been freely utilized since that time.

In 1912, Bone transferred the scene of his activities to London. The Imperial College had awakened to the importance of the study of fuel, and invited Prof. Bone to take over that and allied subjects in London. The headship of that Department was his official position for the rest of his life. The teaching there was post-graduate, and he was enabled to devote most of his energies to the work of research. So early as 1905, he had been elected a fellow of the Royal Society, and in its *Transactions* and *Proceedings* were published most of his contributions to science.

The most striking development in Bone's work on gases was an extension of the study of the phenomena accompanying their oxidation and decomposition under high pressures in ranges including and far surpassing those used in internal combustion engines. In the elucidation of these phenomena, the principles which he accepted and applied were those which had already served him well, and he was very unwilling to depart from them in any way.

Another branch of work which occupied Bone in later years was the investigation of the constitution of coal and other natural fuels by pressure extraction with benzene and oxidation with permanganate. This work proved fruitful in his hands, and was supported by the Department of Scientific and Industrial Research. The distinguishing feature of this investigation, in my opinion, was the thoroughness of the survey undertaken, particularly on the quantitative side. By the establishment of carbon balances Bone was able to show that the products of permanganate oxidation not only contained such substances as benzene carboxylic acids, but also that these were derived in such quantities from even the less matured coals as made it legitimate to conclude that coal was essentially benzenoid in constitution. The value of this and his other research work was so far appreciated that after his retirement from the chair at the Imperial College on reaching the age limit in 1936, arrangements were made for placing at his disposal a laboratory and assistants for the continuation of his work.

Apart from his many published papers and the numerous lectures which he delivered to representative gatherings, Prof. Bone wrote several books on the subjects in which he was specially interested, including "Coal and its Scientific Uses", "Gaseous Combustion at High Pressures", "Coal, its Constitution and Uses", and "Flame and Combustion in Gases". The last-named work was written in collaboration with his assistant, Dr. D. T. A. Townend, and in the last letter which I received from him, Bone expressed his gratification in learning that Townend had just been appointed to the Livesey professorship, of which he had been the first holder. The number of scientific and technical societies, national and other committees, with which Bone had been connected gives some indication of the reputation which he had established, but it is probably as a research worker that he will be best remembered.

JOHN W. COBB.

Mr. J. G. Hides

THE death is reported of Mr. J. G. Hides, explorer in Papua, which took place in Sydney at the age of thirty-two years. Mr. Hides was born at Port Moresby, Papua, and educated in Australia. He joined the Papuan Government service in 1925, and served successively as patrol officer and assistant resident magistrate. He showed an exceptional understanding of native mentality. In 1935 he carried out a patrol lasting eight months, in which he discovered in previously unexplored plateau country an unknown, and as he maintained, new race of light-skinned people. The origin and identity of these people, whose culture displayed a number of features new to Papua, have been the subject of much discussion. Hides, who resigned from the service to take up gold prospecting in 1936, described his experiences and explorations in "Through Wildest Papua" (1935) and "Papuan Wonderland".

WE regret to announce the following deaths:

Dr. A Galt, keeper of the Technological Department, Royal Scottish Museum, Edinburgh, in 1901–20, on June 26, aged eighty-three years.

Mr. W. M. Mordey, known for his work on the development of electro-magnetic machinery and on alternating current magnetism, on July 1, aged eighty-two years.

News and Views

Royal Society of Edinburgh Awards

THE following have been elected honorary fellows of the Royal Society of Edinburgh: *British:* Sir Thomas Lewis, physician-in-charge of the Department of Clinical Research, University College Hospital, London; Prof. G. I. Taylor, Yarrow research professor of the Royal Society, fellow of Trinity College, Cambridge. *Foreign:* Prof. F. Enriques, professor of mathematics, Royal University, Rome; Dr. H. N. Russell, chairman of the Department of Astronomy and director of the Observatory, Princeton University, U.S.A.; and Karl Freiherr von Tubeuf, professor of botany, University of Munich. The joint committee of representatives of the Royal Society of Edinburgh, the Royal Physical Society and the Royal Scottish Geographical Society has awarded the Bruce Memorial Prize (1938) to Mr. Alexander R. Glen for his work in Spitsbergen, including survey in New Friesland and the completion of the map of North East Land. The Council of the Royal Society of Edinburgh has awarded the David Anderson-Berry Prize (1938) to Miss Mary A. C. Cowell, of the Holt Radium Institute, Manchester, for her essay entitled "An Investigation into some of the Factors affecting the Response of Human Skin and Human Skin Tumours to Radiation". The portrait of the president of the Society, Sir D'Arcy Thompson, by Mr. David S. Ewart, was presented by Prof. F. A. E. Crew, on behalf of the subscribers, at the meeting held on July 4.

Tercentenary of James Gregory

THE tercentenary celebrations of the birth of James Gregory began at the Royal Society, Edinburgh, on Monday, July 4, when papers by Profs. H. W. Turnbull, F. Enriques, M. Dehn, E. Hellinger and Dr. O. Prag were presented on the mathematical work of Gregory. On Tuesday, July 5, a special graduation at the University of St. Andrews was held in the Upper Library Hall, where Gregory had worked and made astronomical observations. Honorary degrees were conferred on Profs. G. D. Birkhoff of Harvard, A. W. Conway of University College, Dublin, O. Neugebauer of Copenhagen, R. Weitzenböck of Amsterdam, and (*in absentia*) V. Volterra of Rome. Addresses were received from the Royal Societies of London and Edinburgh, the London Mathematical Society, the Edinburgh Mathematical Society, and the Universities of Edinburgh, Cambridge, Paris, and from others. An exhibition of books and scientific instruments associated with James Gregory was arranged in the Parliament Hall, Library Buildings, South Street, St. Andrews.

Prof. Sigmund Freud, For. Mem. R.S.

AMONG the distinguished scientific men of science who have left Vienna since the *Anschluss* is Prof. Sigmund Freud, who has taken refuge in London. Prof. Freud celebrated his eighty-second birthday on May 6 last. His name will always be associated with the development of psycho-analysis, and the significance of his contributions to psychology was acknowledged by his election in 1936 to foreign membership of the Royal Society, but Prof. Freud had not hitherto been able to sign the roll of membership. Although now resident in London, Prof. Freud was prevented by infirmity from attending the Society's rooms for this purpose, and although the charter book is rarely removed from Burlington House except when it is taken to Buckingham Palace for the signature of the King as patron of the Society, it was decided to extend the privilege to Prof. Freud. Accordingly, on June 23, Sir Albert Seward, foreign secretary, and Prof. A. V. Hill, one of the secretaries, accompanied Mr. J. D. Griffith Davies, who as assistant secretary has custody of the charter book, to Prof. Freud's residence, where the roll was duly signed by Prof. Freud in the presence of his daughter, Dr. Anna Freud, and Princess Marie of Greece, who was a pupil of his and received him when he left Austria. On behalf of the Royal Society, Sir Albert Seward presented to Prof. Freud an inscribed copy of a facsimile of the Society's charter book.

University of Birmingham: Physics Department

IN April last the Council of the University of Birmingham, in considering a request from Prof. M. L. Oliphant for an extension of the Physics Department, regretted that the demands made by the New Medical School would make such an extension impossible unless some private benefactor came forward to provide the necessary money. At the meeting of the Council on June 29, it was announced that Lord Nuffield has offered to give the necessary amount of £60,000. Of this, a sum of £40,000 is to be used for the building, the remainder being reserved for equipment and maintenance and for the foundation of a research scholarship. The plans for the new block provide for a professor's room and secretary's office, a staff room and library. The central part is a large and lofty research hall for high-voltage work, this being flanked by eight small research rooms, each about 16 ft. by 14 ft. There are to be also a machine-room and workshop, two dark rooms, and a basement room for high-energy X-ray work. The general design of the laboratory is such as to lend itself to modification to provide for new developments which may from time to time become desirable. The provision thus made for research will enable the existing physics block (with slight alteration) to be used for teaching purposes for which it was originally intended, and the unsightly temporary huts which since the Great War have been used as an extension of the Department will disappear.

Birmingham Hospitals Centre

THE annual degree congregation at the University of Birmingham on July 2 marked the completion of the new medical school and the Birmingham Hospitals Centre by the conferment of honorary degrees on three laymen whose benefactions and services have been outstanding—Sir Bertram Ford, Viscount Nuffield and Mr. Harry Vincent; and three representatives of the medical profession: Dr. Robert Hutchison, Sir Edward Mellanby, and Sir Cuthbert Wallace. At a luncheon afterwards, the Guild of Graduates entertained the honorary graduates. The chancellor, Viscount Cecil, in proposing the toast of the new graduates, referring to Lord Nuffield, said that he was the successor of a very long line of splendid citizens. They knew he stood for progress, not only physically but also intellectually and morally. When he made his splendid gifts he considered most carefully how they would be for the greatest advantage of the people he was anxious to benefit. "In the case of his gift to our department of Physics, I think he felt that he was not only helping the University of Birmingham or the science of physics, but indirectly, in a most important degree, giving assistance to the industry and intellectual advance of the whole country."

DR. ROBERT HUTCHISON congratulated the City and the University on the great work that had been carried out in forming the Hospitals Centre, and expressed his belief that the example set by Birmingham in the concentration of medical resources in one quarter will be widely followed in other cities. Sir Edward Mellanby said that the fight against disease has as its limiting factor lack of knowledge. The present year has been a particularly good one from the point of view of discovery. One of the greatest discoveries of the time has come from a Birmingham hospital, Dudley Road, namely, the curative properties of the new drug M. and B. 693, which gives us considerable control over that terrible disease, pneumonia. "The greatest part of research is the prevention of disease. This is going on side by side with these other discoveries. This other type of work, the clearing out of disease, is becoming more and more powerful, and I have no hesitation in saying that in fifty years your great hospital here will be put to other uses than it is to-day. It may, of course, be full of motor accidents; or it may be full of very old people whiling away their last years of life in peace and happiness; or it may be occupied by the University for ordinary teaching. At any rate it is going to be quite different, because the rate of progress is so rapid."

National Museum for Southern Rhodesia

IT is reported that a national museum for Southern Rhodesia is to be instituted in the neighbourhood of the Zimbabwe ruins. The trustees of the Southern Rhodesia Sweepstake Lotteries are to be asked to bear the cost of the building, but in the event of their being unable to provide the amount required, the sum necessary will be raised by the Government from its funds. It is to be presumed from the location of the site that the museum, though general in character as a national museum should be, will devote special attention to the antiquities of the adjacent Zimbabwe area and the culture of its native inhabitants past and present, in which the Governments of South Africa have already evinced their interest by the assistance they have given to the archæological investigations undertaken by the joint universities committee for archæological research. Although the situation of the museum may seem somewhat remote from any academic centre, this will scarcely prove a deterrent to the serious student, who will appreciate the advantage of studying the culture of the Zimbabwe in its natural setting, more especially if it should prove possible to get together a really representative selection of the antiquities which have been found in the ruins from time to time. The proximity of the museum to the Victoria Falls, as well as to the ruins, should ensure that it does not suffer from lack of visitors. As an illustration of the most remarkable feature in South Africa's cultural history, such a collection should have the highest educational value.

Prehistoric Research in Great Britain

THE Prehistoric Society (formerly the Prehistoric Society of East Anglia), has recently established a research fund with the object of undertaking the excavation of a series of key sites in Britain in order to develop our knowledge of the prehistory of the country. Of the competence of the Society to undertake the direction and administration of such a fund there can be no question. Its membership of seven hundred includes most of those prominent in the study of prehistoric archæology both in Great Britain and abroad; and among them are those who have been mainly responsible for recent rapid advances in our systematized knowledge of the mesolithic, neolithic and iron age periods in Britain. The advantages which will accrue from a research fund under the control of the Society are patent. The facility for systematic planning of research, combined with flexibility in the application of effort, both of man-power and of financial resources, will make it possible to add effectively to the sum of organized knowledge in those periods and departments of British prehistory where it may be needed most from time to time. A beginning is to be made in this season, when it is proposed to excavate an iron age village site near Britford, one mile south of Salisbury Cathedral. This site is believed to belong to the earlier part of the period 500–100 B.C. The village enclosure was dug out of the chalk by its inhabitants, and its form is known in some detail, but only from photographs taken at a height of 2,000 ft. in air survey, which revealed the existence of the site. The object of the excavation will not be to lay bare the site as such, so much as to throw light on the mode of life and organization of a settlement of small farmers and stock raisers of the period. The Society appeals for contributions to the research fund, which should be addressed to the Honorary Secretary, Mr. C. W. Phillips, Selwyn College, Cambridge.

Flint Implements of the Bronze Age

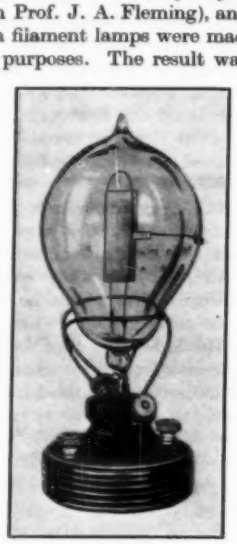
WHAT would appear to be a remarkable collection of flint implements of Bronze Age date, unusually numerous for the period, is reported (*The Times*, June 28) to have been found on Lightlands Farm, belonging to Mr. George Lawrence, of Frant, Sussex. It includes arrow-heads, tanged and barbed, scrapers, knives and flakes. Apparently the implements belong to a pygmy flint industry. The site is half a mile north-east of the camp of Saxonbury. It is on clay soil which has been ploughed for orchards. The flints in consequence have been widely scattered. It is pointed out that such sites are not common in the mid-Weald, to which the raw flint had to be carried either sixteen miles from the North Downs or eighteen miles from the South Downs. Pygmy implements are more commonly found on the sandy sites fringing the Weald.

The Attempt on Mount Everest

ONCE more the attempt to reach the summit of Mount Everest has failed. *The Times* announces that Captain Oliver, a member of the expedition, has returned to Kalimpong and that the other members may shortly be expected there. This year's party was a small one, but included men of great experience. Mr. H. W. Tilman, the leader, Mr. N. E. Odell, Captain P. R. Oliver, Mr. E. E. Shipton, Mr. F. S. Smythe and Dr. C. B. Warren had all had experience on Mount Everest and elsewhere, and Mr. P. Lloyd had distinguished himself on Nanda Devi. A message from Mr. Tilman to *The Times* confirms the news that the attempt has been abandoned for this year. Some details are given. Camp IV on the North Col was reached on May 26, but owing to bad conditions was abandoned five days later. It was reoccupied on June 5 and on the following day Camp V at 25,300 ft. was established. Conditions were not promising although the weather was good at the time. There was an exceptionally early monsoon with heavy snowfalls. Avalanches were unusually numerous and several times endangered the expedition. On June 8, Messrs. Shipton and Smythe established Camp VI at 27,000 ft., where they were joined by Messrs. Tilman and Lloyd, but beyond 27,300 ft. the snow made progress impossible and the attempt was abandoned. Two of the porters are seriously ill, but the rest of the party is well.

The First Radio Valve

SIR FELIX POLE recently made a presentation to Mr. Charles Corbett, who has completed fifty years unbroken service with the Edison Swan Electrical Co., Ltd. Sir Felix pointed out that the company is the oldest electric lamp concern in Great Britain, and is the Company to whom Sir Ambrose Fleming was consultant when he produced the first radio valve. In 1878, Sir Joseph Swan exhibited at Newcastle-on-Tyne the first electric lamp, and in 1881 formed the Swan Electric Light Co., Ltd., to manufacture and market electric lamps. Two years later the names of Thomas Alva Edison and Joseph Swan were coupled by the amalgamation of their interests and patents in the formation of the Edison and Swan United Electric Light Co., Ltd. The factory became established at Ponders End. In 1916, the Company's name was changed to the Edison Swan Electric Co., Ltd. About the time of the amalgamation, Edison noted the irregular blackening of the inside of the lamp bulb during life. Later, this 'Edison effect' was investigated in the laboratory by Sir Ambrose Fleming (then Prof. J. A. Fleming), and a number of special carbon filament lamps were made for him for experimental purposes. The result was, in 1904, the



Fleming thermionic valve. Although this valve was no more than a simple carbon lamp of the period with a metal plate placed between the legs of a hairpin-shaped filament, it could detect wireless signals without the disadvantages common to the old coherers and other mechanical detectors. Much remained to be done before the valve could be brought to that stage of comparative efficiency which was reached with the advent of broadcasting, but something of the physics of the valve had been learned.

University of London Observatory

ON July 1, in spite of a severe thunderstorm during which the roof of Mr. Will Hay's house was set on fire by lightning, one hundred and sixty people attended the opening, by the Astronomer Royal, of the new building of the University of London Observatory at Mill Hill, in which the 24-in. Radcliffe photographic refractor from Oxford and a library have been installed. The Astronomer Royal was introduced to the guests (among whom were the Mayor and Mayoress of Hendon) in a short speech by Sir Frank Dyson, chairman of the University Observatory Committee of Management, and gave an account of some of the circumstances which led to the founding of the Observatory in 1929. This had been largely due, he said, to the enthusiasm of the late Prof. L. N. G. Filon, who was made honorary director, and to Mr. C. C. L. Gregory, who was given the title of Wilson Observer. Mention was made of the Wilson 24-in. reflecting telescope which was presented to the University by Mr. J. G. Wilson, and

also of the gift by Mr. Fry of a smaller instrument, an 8-in. refractor by Cooke. The Astronomer Royal described the Radcliffe telescope as a sister telescope to the one now being used at Greenwich for parallax determinations, and hoped that much useful work along similar lines would be done in the future at Mill Hill, in keeping with the past traditions of the Radcliffe Observatory. The Radcliffe Observatory has now been removed to Pretoria, where the largest telescope in the southern hemisphere is being erected. The Vice-Chancellor, Sir Robert Pickard, thanked the Astronomer Royal on behalf of the University for performing the opening ceremony.

Museums and Rural Life

In supporting the appeal for a further £5,000 for the endowment fund which was launched at the jubilee celebrations of the Haslemere Educational Museum, Dr. John Ramsbottom, president of the Linnean Society, stressed the great importance of teaching people of all classes how best to spend their leisure. The Haslemere Museum, he said, is worthy of unreserved praise, for it is part of the communal life of the district. Children and adults bring specimens of all kinds to the Museum for identification and are assured of receiving information, whether it be a matter of local history or natural history. He also referred to the magnificent display of British wild flowers with their names and such information as is sure to appeal, that is maintained in the Museum throughout the year. Lord Winterton suggested that research into the origin of the old wage-earning families in the neighbourhood of Haslemere would prove most interesting, for many of them are descended from migrants from France or Flanders in the fourteenth and fifteenth centuries. During that time there was a big trade between the Sussex and Hampshire ports with France and considerable migration between the two countries; also large numbers of workers came over for the extensive glass industry then existing in the south of England. In those days, when anyone made any money, it was put into land, and many of the place names—such as those of the woods, fields and so on in the neighbourhood—give indications of the names of the worker-immigrants, some of them also being of Saxon origin.

Linnæus in England

The Year Book of the Swedish Linnean Society for 1938 (Svenska Linné-Sällskapets Årsskrift, Årg. 21) opens with a dedication to the Linnean Society of London on the occasion of its sesqui-centenary, in which the elder Society is greeted as "chirographorum Caroli Linnaei pia conservatrix". The volume contains a long account, illustrated by photographs and drawings, of Linnæus's house in the old Botanical Gardens at Uppsala and of the way in which it has now been skilfully restored as nearly as possible to the state in which it was when Linnæus lived in it. Of the other articles one, by the editor, Mr. A. Hj. Uggla, is of special interest to readers in Great Britain, since it deals with two recently discovered documents bearing on Linnæus's connexion with England. One is a draft of a letter intended for, and perhaps actually sent to, Dillenius at Oxford in 1733, when Linnæus was twenty-five years old, and shortly after his expedition to Lapland. It is written in Latin and ends by expressing the hope that he might one day meet Dillenius. This hope was fulfilled when Linnæus visited Oxford three years later. The other document is a letter written in August 1735 by J. F. Gronovius in Leyden to Philip Miller, superintendent of the Apothecaries' Garden at Chelsea. It is written in English and states that Linnæus, then in Leyden, "hath a mind to make a step over to England to be acquainted with you. . . . I am sure you will be pleased with his company, but it will bee troublesome for him as only speaking his own Language and Latin, however I think the Swedish minister at London can procure him an interpreter".

Experimental Fire-Walks

A report by Dr. G. Burniston Brown on three experimental fire-walks has recently been issued ("A Report on Three Experimental Fire-Walks by Ahmed Hussain and others". By Dr. G. Burniston Brown. Bull. 4. University of London Council for Psychical Investigation, 19 Berkeley Street, Mayfair, London, W.1. 1*s*. net). The experiments were made at Carshalton, where Kuda Bux had also been tested (see Nature, **136**, 468, 521; 1935) and at the Alexandra Palace. The accompanying table shows a comparison of the most successful attempts made by Ahmed Hussain, R. Adcock and Kuda Bux.

	Weight	Distance walked	Surface temp. (°C.)	No. of steps	Time	Minimum mean time of contact per step
Hussain	126 lb.	12 ft.	800°	4	1·6 sec.	0·40
Adcock	160 ,,	12 ,,	800°	3	1·8 ,,	0·60
Kuda Bux	120 ,,	11 ,,	430°	4	2·2 ,,	0·55

The results of the experiment showed that the fire-walk is not a trick, but is performed in the normal manner with bare and chemically untreated feet. Moisture on the feet was shown to be a disadvantage, since it may cause hot particles to adhere to the skin and thus cause blisters. The sudden formation of an insulating cushion of vapour between the foot and the hot embers does not occur, and no abnormal degree of callosity of the feet is required.

The "Invisible College", 1645–1662

In the Moravian literary publication, *Miscellanea*, Dr. R. F. Young recently gave an account of the "Invisible College" which preceded the foundation of the Royal Society in 1662. The term was used to describe the periodical meetings of men of science at either London or Oxford, and Dr. Young points out that the contemporary meaning may have been derived in four possible ways. In the first place, it may be an Italian *concetto* adopted directly by Boyle from the name of a literary academy at Cremona. It may have been borrowed from the contemporary critics and opponents of the "invisible" Rosicrucians, such as J. V. Andreae (1586–1654). A third view is that it was a reminiscence of an elaborate play on

the word 'invisible' contained in Shirley's comedy "The Bird in a Cage" (1633). The last possibility, towards which the author leans, is that it was a title devised by Theodore Haak to contain an implicit allusion to Comenius's plan of an international pansophic college for scientific research to be erected in London. This plan was much to the fore during Comenius's visit to England in 1641–42, and the scheme was set out in detail in his manuscript treatise, "Via Lucis" (1642). Haak was a German from the Palatinate who had been one of the principal supporters of the plan to establish a scientific academy in London. He regarded the informal scientific meetings as the nucleus of a future State college of science and is likely to have used the expression "Invisible College" in conversation with Boyle and others. The "Philosophical College" was thus the "Invisible College", until it definitely became the Royal Society.

Medicine and Eugenics

THE Galton Lecture to the Eugenics Society, by Prof. John A. Ryle, on medicine and eugenics, is printed in the *Eugenics Review*, **30**, No. 1. In a carefully considered address, it is pointed out that the eugenic movement needs the fuller support of the medical profession, and that this can only be given when medical men receive a fuller training in human genetics than is now the case. The family doctor is now rarely prepared, even if asked, to give advice connected with eugenic prognosis, although men and women are increasingly prepared to discuss such matters. Practising physicians should be able to keep pedigree records of their patients who show mental and physical defects. Medical education should be altered so as to lay greater stress on animal and human genetics in place of some of the routine zoology and the more specialized biochemistry and biophysics. The constitutional variations which abound should be the subject of closer genetic study. Several chairs of human genetics should be instituted, and associated with them should be research centres concerned with morbid inheritance in man. Wider contacts of the Eugenics Society with medical societies throughout the country would be helpful. The foundation of a National Council is advocated, embodying an alliance between medicine, eugenics and sociology and having appropriate contacts with the Ministries of Health, Agriculture and Labour. The preservation of health as a primary function, with the treatment of disease as a secondary function, should become the new ideal.

Forestry in Nyasaland

PERHAPS the most important information contained in the annual report of the Forestry Department for the Nyasaland Protectorate (for the year ending December 31, 1936. Govt. Printer, Zomba, Nyasaland, 1937) are the remarks on soil erosion and the investigation work now being undertaken in this, considered to be one of the greatest dangers facing Africa as a whole. Extensive areas were examined with particular regard to overcrowding and to cultivation on steep hill slopes in parts of the southern province. On the subject of forest policy it is stated that provision is to be made for the demarcation, protection, and management of selected forests and woodlands by native authorities, where the objects of conservation are comparatively local. These local Government forests will be supplementary to the State forests, but they will in no way supersede the village forests which are managed by the village headmen solely in the interests of village needs. There will thus be three types of demarcated forests in the future, each managed by its own authority. One of the chief dangers in many parts, owing to the improvident habits of the people, is erosion. Provided that each type of forest reservation may be made to serve as a protective agent against this evil, the steps now being taken appear to meet existing problems.

Science and Horticulture

VOL. 6 of *Scientific Horticulture* (260 pp., 1938, from the Editor, R. T. Pearl, S.E. Agric. Coll., Wye, Kent, 4*s*. net, 4*s*. 6*d*. post paid) the journal of the Horticultural Education Association, contains a very useful series of reviews upon the science and practice of horticulture. A suitable introduction is provided by Mr. F. A. Secrett, who writes upon the enterprise and skill requisite for successful market gardening, and the need for "evolving schemes to assist Nature". The article is the text of an evening address delivered at the University of Reading during the Association's revision course in horticulture in September 1937. Papers read at this course are published in the present volume; they minister chiefly to the needs of flower growers, with emphasis upon carnations, roses, pot plants and chrysanthemums, both early and late. There are further papers on genetics in relation to horticulture, the nature of inheritance of flower colour, and on photoperiodism. Papers contributed specially to the volume include a review of recent Dutch research upon the growth and flowering of tulips and daffodils by Miss O. N. Purvis, upon hormones (M. Thomas), boron deficiency (A. W. Greenhill), chromosomes and their importance in horticulture (F. W. Sansome) and the place of school gardening in elementary and secondary schools (J. Ewing). The production of virus-free seed potatoes is discussed by P. A. Murphy, and the modified leader tree by T. Swarbrick, whilst the formation and development of cherries is described by M. B. Crane.

The Royal Technical College, Glasgow

IN the building up of the world-wide reputation of the 'Scots engineer', the Royal Technical College, Glasgow, may fairly claim to have played a very large part, and much of this work has been done in its evening classes. It is noteworthy that of all the colleges that come within the purview of the University Grants Committee, the R.T.C. has far and away the largest number of evening students. Its recently published annual report shows that, notwithstanding the transfer of the classes in music, with about a hundred students, at the end of the preceding session, to the Scottish National Academy, there was an increase in the evening student enrolment from 2,624 to 2,665, of whom a very large

majority were engineering students. Some indication of the exceptional range and standard of the evening classes is given by the fact that the enrolment included 100 graduates of universities of Scotland, England, Ireland, Canada, India and China. An important, and seemingly long overdue event of the year was the formation of a Former Students' Association with a membership of seven hundred and correspondents in many parts of the world. The Association aims at "enabling former students to retain an interest in the affairs of the College" and as the honorary secretary is a member of the staff it may be hoped that it will help the College to retain an interest in the former students. An important source of strength for the College is the scheme of affiliation of continuation classes conducted by eight county education authorities and attended by more than seven thousand students. The Glasgow Careers Council (for Secondary Schools) co-operates with the Ministry of Labour in promoting visits of boys and girls with their teachers to various departments of the College.

University Studies at Jerusalem

A BULLETIN recently issued by the Hebrew University at Jerusalem discloses the fact that Polish students largely outnumber all others. The total enrolment last year was 779, including 48 research students. Of the undergraduates, 433 were from Poland, 150 from Palestine, 49 from Germany, 35 from Lithuania and Latvia, 17 from Rumania and the rest from 18 other countries. The same bulletin contains an article by Dr. Dushkin, lecturer in educational method and administration, on the various activities of his department, including measures for improving and extending the teaching of Arabic. In the Palestinian schools, Arabic has been taught like Latin or Greek, with stress upon the analysis of grammatical forms and translation of classic texts. The University's policy is, on the contrary, to emphasize the conversational aspects of the language and to promote the employment of a minimum course for all Jewish children in colloquial Arabic, with simple reading and writing and instruction in Arabic folk-ways and customs. This is a difficult task owing to the prevalence of a snobbish contempt for the 'vulgar' spoken language of the common people, which differs widely from the classic Arabic of literature and is not taught by the Arabs in their own schools. The department is largely under the influence of American educational theory, the chair of the principles of education being held by Prof. Kaplan of New York, for many years a professor at the Jewish Theological Seminary there and principal of its Teachers' Institute, and a leader of the Society for the Advancement of Judaism and of the Reconstruction Movement in American Jewry.

King Edward's Hospital Fund for London

THE fortieth annual report of King Edward's Hospital Fund for London, recently issued and covering the year 1936, gives an account of the finances of the Fund and of the grants recommended. The ordinary distribution remained unchanged at £300,000, to which was added a first contribution of £2,000 in respect of work done for hospital out-patients by district nursing associations. Grants were made to 146 hospitals and 56 convalescent homes. The contributions to the Fund included a capital gift of £20,000 from His late Majesty, King George V. The Fund has acquired an additional 7 grams of radium, thus bringing the amount under the Fund's control up to a total of 17 grams. An account is given of the work of the Propaganda Committee, which includes the production of a new film on hospital progress, specially suited to school audiences.

Eradication of Bovine Tuberculosis

THE Register of Attested Herds in Great Britain, under the Tuberculosis (Attested Herds) Schemes, which has been recently published, gives particulars of the herds on the Register on December 31. At that date there were 812 attested herds with 37,000 cattle in England and Wales, and 640 herds in Scotland with 50,500 cattle, a considerable increase over the previous year. The Register gives the names and addresses of the owners and the breeds of cattle, and can be obtained on application to the Ministry of Agriculture and Fisheries, 7 Whitehall Place, London, S.W.1, or, for Scotland, 15 Moray Place, Edinburgh, 3. The issue of a certificate of attestation is evidence that the owner of the herd has taken steps to eradicate tuberculosis from the herd, and that as a result of an official tuberculin test, the herd has been found to be free from tuberculosis.

Air-borne Traffic and Infectious Diseases

THE Minister of Health has made regulations, similar to the Port Sanitary Regulations, 1933, designed to prevent the introduction of infectious diseases into Great Britain through the medium of air-borne traffic which came into force on July 1. The authorities responsible for the administration of these "Aircraft Regulations" are the port health authorities for aerodromes at ports, and elsewhere the local authorities of the districts in which the aerodromes are situated. The regulations authorize, if necessary, temporary detention of aircraft, medical inspection of passengers and crews, cleansing, disinfection, etc. The issue of these regulations marks a further advance in the policy for the provision of health services suitable for modern conditions.

The Vale of Neath

THE National Museum of Wales has initiated a series of studies of the origin of Welsh scenery with a small pamphlet on the "River Scenery at the Head of the Vale of Neath", by Dr. F. J. North. The area covered is about sixty square miles and is one of great scenic charm. The studies do not necessarily embody original work, but they aim at giving popular descriptions of the origin of the land forms with as little use of technical terms as possible. Where technicalities are unavoidable they are fully explained. The present study is a good example of intelligent popularization both in its wording and its diagrams and illustrations.

Old Science and Medicine

E. P. GOLDSCHMIDT AND CO., of 45 Old Bond Street, W.1, have recently issued an illustrated and annotated catalogue of works of old science and medicine, comprising important books in the history of the mathematical and physical sciences, biology and medicine. The most valuable works figuring in the catalogue are the complete manuscript of the "Chirurgia Magna" of Bruno de Longoburgo (1250), Pierre Franco's treatise on hernia (1561), the Aldine *editio princeps* of Galen's works in five volumes (1525), Robert Hooke's Cutlerian Lectures on physics, mechanics, geography and astronomy (1674–1678), Claude Perrault's memoirs on the natural history of animals in two volumes (1671–76), and theses by pupils of Linnæus (1749–1769) and Purkinje (1824–1840). The catalogue also contains first editions of works by Tycho Brahe, Euclid, Fracastor, Goethe, Laennec, Lamarck, Lavoisier, Napier, Röntgen, Schwann, Sirturius, Steno, Tartaglia and Willis. Modern literature is further illustrated by works by Edison, Freud, Casimir Funk, Metchnikoff, and Hugo de Vries.

Royal Anthropological Institute

THE annual meeting of the Royal Anthropological Institute was held on June 28 when Mr. H. J. Braunholtz delivered his presidential address entitled "Ethnographical Museums and the Collector: Aims and Methods". Two Rivers Memorial Medals for 1938 were presented, to Prof. A. R. Radcliffe Brown for anthropological research in the fields of the Andaman Islands and Australia, and to Miss D. A. E. Garrod for work in Gibraltar, Southern Kurdistan and Palestine. The Wellcome Gold Medal for 1937 for anthropological research was awarded to Dr. Meyer Fortes for a thesis on "Marriage Law among the Tallensi".

World Power Conference: Vienna Meeting

THE Vienna Sectional Meeting of the World Power Conference will take place on August 25–September 2. A programme has been issued giving details of the sessions and sectional meetings, the social events planned for the participants, the sight-seeing tours and the Conference journeys. The official opening meeting in the Vienna Concert House is at 10 a.m. on Thursday, August 25, and allowing Saturday and Sunday for sight-seeing, the meeting goes on until Friday, September 2, when a second week begins devoted to tours of exceptional interest. Messrs. Thos. Cook and Son have been officially authorized to act as travel agents. Payment of all fees, which are most reasonable, can be made in English currency. The railway administrations grant substantial reductions in fares to all the participants at the Vienna meeting. Among other excursions on Monday, September 5, there will be one over the Gross Glockner Pass. This road has an almost perfect surface and owing to the wonderful road building technique, the gradient is never more than 12 per cent. It is a marvellous piece of engineering. The excursion goes to the Franz-Josefs-Hohe (7,370 ft.) where there is a wonderful view of the Pasterze Glacier, the longest glacier of the Eastern Alps. Full particulars of the fortnight's programme, charges, accommodation, etc., can be obtained from the Secretary, British National Committee, World Power Conference, 36 Kingsway, London, W.C.2.

Announcements

MR. H. N. SAVOURY, of St. Edmund's Hall, Oxford, and MacIver Research Student of Queen's College, has been elected by the Faculty of Archæology, History and Letters of the British School of Archæology at Rome to the Rome Scholarship for 1938. Mr. Savoury will devote the period of his tenure of the scholarship to research on certain aspects of the neolithic, bronze and early iron ages in Italy, and the influence of Italy on the lands north-west of the Alps and on Iberia during the early Bronze age.

THE Busk studentship in aeronautics, founded in memory of Edward Teahmaker Busk who lost his life in 1914 while flying an experimental aeroplane, has been awarded for 1938–39 to G. O. Jones, Emmanuel College, Cambridge.

DR. ADALBERT CZERNY, formerly professor of children's diseases in the University of Berlin, has been awarded the shield of nobility of the German Reich on the occasion of his seventy-fifth birthday.

A MONUMENT to Dr. Albert Calmette, the well-known authority on tuberculosis, has recently been unveiled at Nice.

THE Public Health Services (Engineering and Equipment) Exhibition and Congress, formerly the Public Health Exhibition and Congress, will be held at the Royal Agricultural Hall, London, on November 14–19.

THE International Congress of Light will be held at Davos, Switzerland, on July 29–30 under the presidency of Dr. Morikofer. The subjects for discussion will be light and climatology, action of natural and artificial light on healthy and diseased organs, and physiological and physical study of the therapeutic sources of light. Further information can be obtained from Dr. Schreiber, Robert Koch Platz 1, Berlin.

THE Child Welfare Information Centre of the League of Nations has published a useful "Summary of the Legislative and Administrative Series of Documents of the Child Welfare Information Centre to December 31st, 1937" (Messrs. Allen and Unwin, 40 Museum Street, London, W.C.1. 1*s*.). It contains brief details of enactments in various countries between February 1936 and December 1937, dealing with matters of child welfare.

ERRATUM. In the issue of July 2, p. 31, line 5, for "Pinex" read "Pinax".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 78.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Tides in the Upper Atmosphere

THE exploration of the physical state of the upper atmosphere by radio waves has, so far, been principally concerned with the investigation of the distribution of ionization and with the regularities and irregularities in this distribution due to solar control. In a series of measurements made during the past year, we have endeavoured to extend the employment of radio waves to the investigation of upper-atmospheric oscillations. Such oscillations would include tides produced by the gravitational influence of the sun and the moon, and would result in both vertical movements of individual air particles and also in variations of the atmospheric pressure at a given level. The influence of the moon has been examined first, since, the effect being purely gravitational, there is no need to unravel, as in the solar case, the simultaneous effects of tidal motion and varying height of ion-production. Further, for various theoretical and experimental reasons, attention has been confined to the level of Region *E* of the ionosphere.

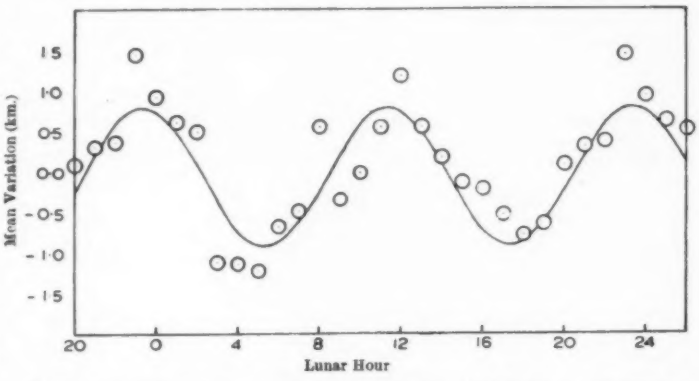
For the investigation of the lunar tide, it was necessary to eliminate the variation of the height of the reflecting layer with angle of the sun, since this variation is many times the expected lunar oscillation. This was accomplished in the two following ways :

(*a*) A series of quarter-hourly measurements of equivalent height of reflection for a number of days (usually six to eight in a period of twelve days) was plotted to exhibit the diurnal variation. The departures from the smooth mean curve were then plotted as a function of lunar hour.

(*b*) A series of noon values of equivalent height were plotted to exhibit the seasonal variation, and the daily departures from the smooth curve were plotted as a function of lunar hour.

The accompanying diagram shows the hourly mean departure as a function of lunar hour, the full curve giving the semi-diurnal lunar variation of equivalent height as deduced from the points by harmonic analysis. The curve is derived from quarter-hourly measurements made, during different groups of days, throughout a period of eight months. A seasonal set of measurements has indicated a tide of the same magnitude and phase, the maxima being about $\frac{3}{4}$ hour before the lunar transits.

We hope to publish elsewhere a full account of the evidence which leads us to regard this tidal amplitude as significant, together with a discussion of the relation of these results to previous work. We may, however, mention here that we regard them as showing a pressure oscillation of relative amplitude $(\delta p/p)$ of 0·068 at a level of 110 km., whereas the measurement of the lunar barometric oscillations at ground-level show a corresponding relative amplitude of 0·0000115[1]. The tide at 110 km. is thus 5,900 times that at ground-level. Further, to the accuracy of the experimental results, the phase of the upper-atmospheric tide is the same as that at ground-level at Greenwich, a result in disagreement with deductions made from the lunar magnetic variations, assuming such variations to arise from currents flowing in Region *E*.



LUNAR VARIATION OF EQUIVALENT HEIGHT OF REGION *E* OF THE IONOSPHERE

These experiments have been conducted as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research.

E. V. APPLETON.
K. WEEKES.

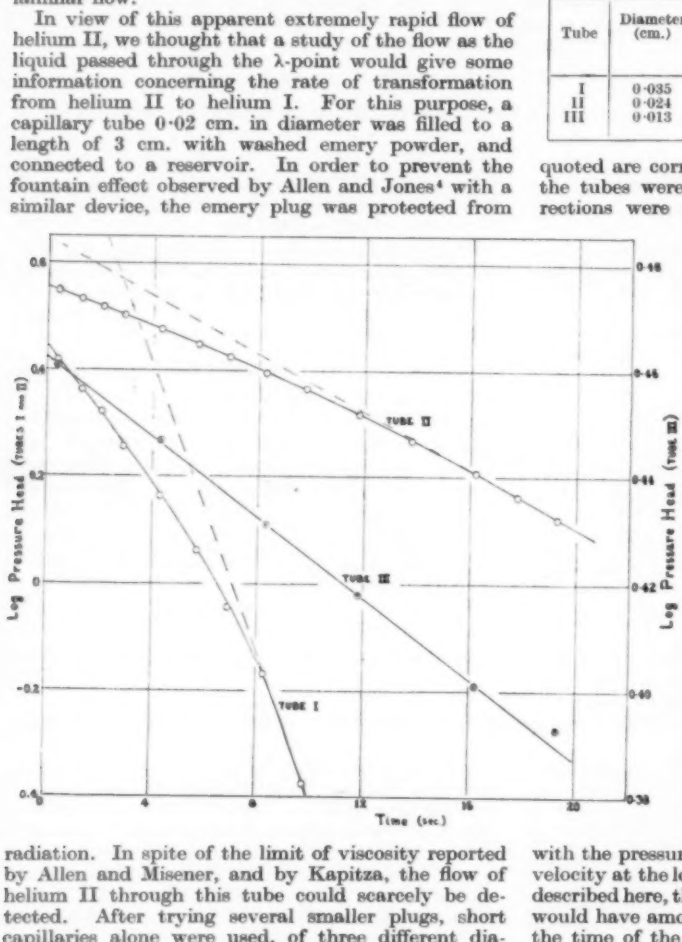
Cavendish Laboratory,
Cambridge.
June 17.

[1] Chapman, *Quart. J. Royal Meteor. Soc.*, **44**, 271 (1918).

Viscosity of Liquid Helium II

IN recent experiments on the flow of liquid helium II through very small openings, carried out by Allen and Misener[1], and by Kapitza[2], an upper limit to the viscosity was placed at 10^{-9} c.g.s. units, in definite disagreement with previous results obtained in this laboratory by Wilhelm, Misener and Clark[3] by means of an oscillating cylinder. However, in none of these experiments were conditions such as to ensure laminar flow.

In view of this apparent extremely rapid flow of helium II, we thought that a study of the flow as the liquid passed through the λ-point would give some information concerning the rate of transformation from helium II to helium I. For this purpose, a capillary tube 0·02 cm. in diameter was filled to a length of 3 cm. with washed emery powder, and connected to a reservoir. In order to prevent the fountain effect observed by Allen and Jones[4] with a similar device, the emery plug was protected from radiation. In spite of the limit of viscosity reported by Allen and Misener, and by Kapitza, the flow of helium II through this tube could scarcely be detected. After trying several smaller plugs, short capillaries alone were used, of three different diameters. These were attached to reservoirs 0·4 cm. in diameter, which were fastened side by side to a millimetre scale, and arranged so that they could be raised or lowered in the liquid helium bath. To measure the rate of fall of the surfaces, a motion picture camera was used, and arranged to photograph the tubes and a stop watch simultaneously. In the first experiments the tubes were lowered into helium II at a temperature a little below the λ-point, and the flow into the tubes was observed as the temperature was slowly raised through the transformation to helium I. However, the change in the rate of flow on passing through the λ-point was not greatly marked, and so measurements at fixed temperatures in helium II were made.



In no case did the results suggest that the liquid helium II was behaving as a 'super-fluid'. In the accompanying diagram, the logarithm of the pressure head is plotted against the time, for a series of measurements at 2·16° K. It will be seen that, for the slower rates of flow, the relation is linear, showing that the rate was nearly proportional to the pressure. The viscosity has been calculated from these results, and is given in the accompanying table. The values

Tube	Diameter (cm.)	Length (cm.)	Viscosity (c.g.s. units)	Velocity for small pressure heads (cm./sec.)	Reynolds number
I	0·035	1·8	$7·9 \times 10^{-5}$	21	750
II	0·024	1·9	$7·8 \times 10^{-5}$	28	670
III	0·013	1·7	$5·4 \times 10^{-5}$	13	170

quoted are correct in order of magnitude only, since the tubes were not very uniform, and no end corrections were made. Using this estimate of the viscosity, the Reynolds number has been calculated, and in all three cases is less than 1,000 for the smallest velocity measured. We hope, by using more uniform tubes, to obtain more accurate values for the viscosity.

These results are not compatible with those of Allen and Misener, or of Kapitza, but agree in order of magnitude with the earlier work of Wilhelm, Misener and Clark. We suggest that in the case of the long, fine capillary used by Allen and Misener, the observations can be explained by the transport phenomenon studied by Daunt and Mendelssohn[5]. According to the results reported by the latter, the level in the reservoir used by Allen and Misener would have fallen at a rate of about 0·02 mm. per second at 2·17° K. due to transport over the surface of the tube. This would account for the observed drop, and it seems probable that the actual flow through the long capillary was negligible. This would also account for the fact that the velocity did not vary greatly with the pressure head, and for the large increase in velocity at the lower temperature. In the experiments described here, the change in level due to this transport would have amounted to only about 0·1 mm. during the time of the experiment, less than 1 per cent of the observed change. On the other hand, the rates of flow observed by Allen and Misener with a larger tube and reservoir, and that observed by Kapitza, seem too large to be fully accounted for by the surface transport, and further experiments on both the flow and the transport are highly desirable.

The work described above was carried out by H. E. Johns, J. O. Wilhelm, and Dr. H. Grayson Smith.

McLennan Laboratory, University of Toronto. E. F. BURTON. (Director.)

[1] Allen, J. F., and Misener, A. D., NATURE, 141, 75 (1938).
[2] Kapitza, P., NATURE, 141, 74 (1938).
[3] Burton, E. F., NATURE, 135, 265 (1935); Wilhelm, J. O., Misener, A. D., and Clark, A. R., *Proc. Roy. Soc.*, A, 151, 342 (1935).
[4] Allen, J. F., and Jones, H., NATURE, 141, 243 (1938).
Daunt, J. G., and Mendelssohn, K., NATURE, 141, 911 (1938).

Production of Secondary Electrons by Cosmic Ray Particles

SOME early measurements of Anderson and Neddermeyer[1] show that the number of single secondary electrons ejected by cosmic ray particles from a metal plate is in reasonable agreement with that to be expected from direct elastic collisions. In a series of photographs we have observed the traversal of a 2 cm. plate of gold by about 900 particles, all of which may be assigned to the penetrating group. With this gold plate, which has a thickness of 8·5 in the units of the cascade theory, the behaviour of electrons can be immediately distinguished from that of the penetrating particles, and so the behaviour of the penetrating rays can be examined separately. On the assumption that these penetrating rays have a mass greater than that of electrons, Bhabha[2] has calculated the number of ordinary secondary electrons knocked on by collision and the subsequent cascade showers that the latter produce. The particles are considered in two energy groups, above and below 3×10^9 e. volts, previous measurements of the energy spectrum for the magnetic field and counter arrangement used having shown that 44 per cent of the observed rays have an energy greater than 3×10^9 e. volts. For convenience of the comparison with theory, the secondary electrons have been classified into those with energy greater and less than the critical energy of the cascade theory, for gold, 10^7 e. volts.

In the group of particles with energy greater than 3×10^9 e. volts, the total number of secondaries observed with energy greater than 10^7 e. volts was 4·4 per cent of the number of primary particles. The corresponding number of secondaries for the energy range below 3×10^9 e. volts was 0·4 per cent.

The table below shows the frequency of occurrence as a percentage of the penetrating particles of (*a*) single secondary, (*b*) two secondaries, (*c*) three or more secondaries.

	Energy of Primary (e.v.)	(*a*)	(*b*)	(*c*)
		1	2	>2
All observable secondaries	$> 3 \times 10^9$	3·3	0·3	0·3
	$< 3 \times 10^9$	0·8	—	—
Secondaries of energy $> 10^7$ e. volts	$> 3 \times 10^9$	2·8	0·3	0·3
	$< 3 \times 10^9$	0·4	—	—

We observe relatively few slow secondaries, with energy less than 10^7 e. volts, but this is due, at least in part, to the strong scattering of these particles.

The measurements give a rough indication of the mass of the main penetrating component of the rays. In Fig. 1 the total number of secondary particles of energy greater than 10^7 e. volts to be expected from the calculations of Bhabha[2] for penetrating particles of 10 and 100 times the electron mass and for protons is shown, and the measured values for the two groups of particles are plotted. These values are probably low, in comparison with the theoretical curves, since the theory does not take account of scattering, but they are sufficient to indicate a mass of the penetrating particles at least 100 m_0 and probably greater.

Thus these results show that the observed number of secondary electrons can be explained by the elastic collisions of the penetrating rays with electrons, assuming that the former have a mass rather greater than 100 m_0. The energy loss corresponding to this process can be seen from Bhabha's calculation to be of the order of one third of the ionization loss alone.

Now for energies between 10^9 and 2×10^9 e. volts, direct measurement[3,4] has shown a much larger energy loss, of the order of ten times the ionization loss. It follows that the main part of this energy loss must occur without producing observable secondaries.

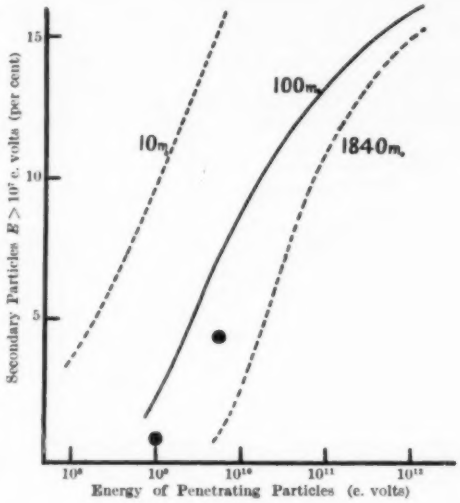


Fig. 1.

Fig. 2 shows the production of a small shower of four electrons by a penetrating particle of high

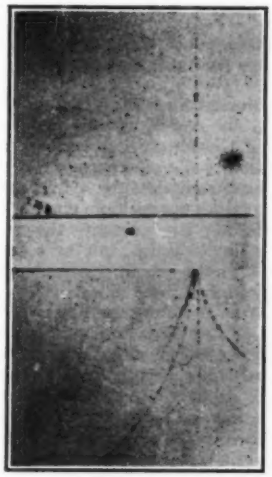


Fig. 2.

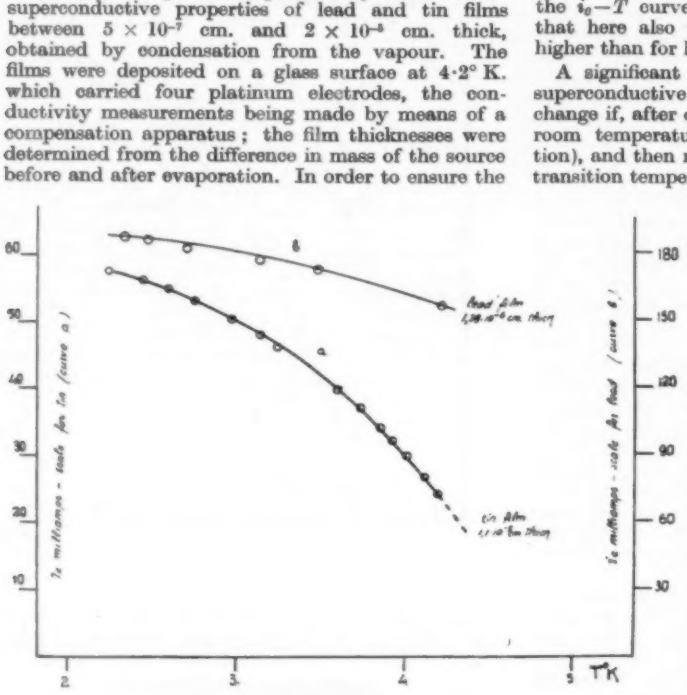
energy. The fastest electron has an energy of about 3×10^7 e. volts. A similar photograph has been reported by Ehrenfest[5].

Physical Laboratories, University of Manchester. June 3. J. G. WILSON.

[1] Anderson and Neddermeyer, *Int. Conf. Phys. Lond.*, 182 (1934).
[2] Bhabha, *Proc. Roy. Soc.*, A, **164**, 257 (1938).
[3] Blackett and Wilson, *Proc. Roy. Soc.*, A, **160**, 304 (1937).
[4] Wilson, *Proc. Roy. Soc.*, A (in the Press).
[5] Ehrenfest, *Comptes rendus*, **206**, 428 (1938).

Superconducting Thin Films

WE wish to report some preliminary results on the superconductive properties of lead and tin films between 5×10^{-7} cm. and 2×10^{-5} cm. thick, obtained by condensation from the vapour. The films were deposited on a glass surface at 4·2° K. which carried four platinum electrodes, the conductivity measurements being made by means of a compensation apparatus; the film thicknesses were determined from the difference in mass of the source before and after evaporation. In order to ensure the cleanest possible conditions, the condensation and measurements were made in a sealed-off high-vacuum apparatus.



Even the thinnest films investigated showed superconductivity. The resistance was restored in a single abrupt jump if the measuring current was increased beyond a critical value i_c characteristic of the particular film and temperature; further increase of current produced no appreciable change of resistance. On again reducing the current, the resistance disappeared in a single jump, but at a lower value of current than i_c; the whole resistance-current curve could be reproduced any number of times. The value of i_c at a given temperature decreased with the thickness of the film, and was in general of the order of magnitude of some milliamperes; in all cases this was very much smaller than could be expected from Silsbee's hypothesis, supposing the critical field to be the same as for the bulk metal.

Actually, however, the magnetic fields required to restore the resistance were not lower, but much higher than for the bulk metal; thus a magnetic field even as high as several thousand gauss, applied parallel to the current, reduces the value of the critical current, but this influence is only slight (especially for the thinner films). With increase of the film thickness the magnetic field required to destroy superconductivity decreases.

The critical current decreases with increase of temperature, and in the case of tin, it was possible to estimate the transition temperature by extrapolation of the accompanying $i_c - T$ curve (Curve *a*) to zero i_c. This suggested a transition temperature of about 4·7° K. for all the tin films, which is about 1° higher than for tin in bulk. For lead this extrapolation is not possible, owing to the flat course of the $i_c - T$ curve (Curve *b*), but the curve suggests that here also the transition temperature may be higher than for lead in bulk (7·2° K.).

A significant feature of the results is that the superconductive properties underwent a marked change if, after deposition, the films were warmed to room temperature (probably causing recrystallization), and then recooled. Thus in the case of tin the transition temperature dropped to about 3·7° K. (the value for bulk tin); for a temperature equally far below the transition temperature the magnetic fields required to restore resistance became rather smaller, and i_c became rather greater.

Since all the properties (except the sharpness of the transition between super- and normal conductivity) are very reminiscent of those of super-conductive alloys, it seemed that the anomalously high transition temperature of freshly deposited tin might be connected with the presence of impurities; variation of cleanliness of the condensation conditions, however, caused no change of the high transition temperature, so it is likely that this is genuinely characteristic of the *structure* of films deposited at 4·2° K. How far the other anomalous properties are connected with the structure and how far with the thinness of the films, must remain a question for further investigation, but the results, so far, suggest that the structure can scarcely be responsible alone.

A. SHALNIKOV.

Institute for Physical Problems,
Academy of Sciences of the U.S.S.R.,
Moscow.
April 27.

Melting and Structure of Long-Chain Ketones

A NUMBER of isomeric long-chain ketones have been prepared and specially purified, in the course of investigations on the solid-liquid transition in long-chain compounds[1]. As will be clear from the diagram for the ketones $C_nH_{2n+1}COC_{(18-n)}H_{32-2n}$, the setting points depend in a remarkable way on the position of the CO dipole in the long-chain molecule. The maximum difference (between $C_8H_{17}COC_8H_{17}$ and $C_5H_{11}COC_{11}H_{23}$) of 9·2° may be compared with the difference in setting points between $C_5H_{11}COC_{11}H_{23}$ (s.p. 40·8°) and the corresponding paraffin $C_{17}H_{36}$ (s.p. 21·6°).

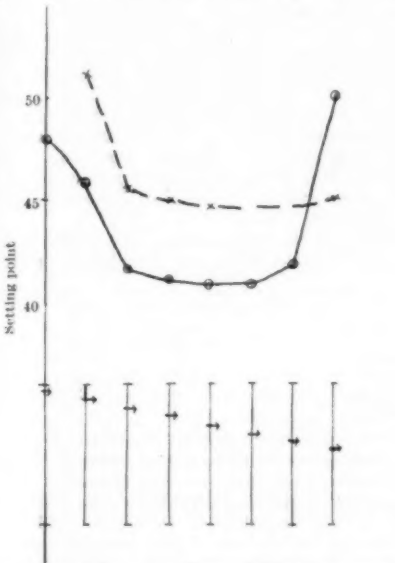
In order to verify that this behaviour is not confined to chains with an odd number of carbon atoms, ketones of the series $C_nH_{2n+1}COC_{(17-n)}H_{34-2n}$ have also been prepared, and show a corresponding behaviour. A survey of published melting points of other ketones suggests that this effect is quite general.

In view of the comparatively simple crystal structure of long-chain compounds[2,3], these observations are of interest for theories and mechanical models of the melting of crystal lattices. A detailed analysis of the crystal structure of a long-chain

ketone has not yet been achieved, partly owing to the lack of suitable single crystals. The comparison of X-ray powder photographs of ketones with the corresponding paraffins shows, however, that the introduction of the CO dipole only leads to small changes in the side spacing of the chains, when these are sufficiently long. For compounds of the series $C_{17}H_{36}$ the lattice dimensions are:

	a	*b*	*c*
$C_{17}H_{36}$	7·63	4·91	23·26
$C_{17}H_{34}O$	7·55±0·01	5·79±0·06	23·26

and any differences between the isomeric ketones are within the errors of measurement. In view of the intensity determinations on X-ray powder photographs of ketones due to Shearer[2], it may be assumed



DATA FOR $C_{18}H_{36}O$, CROSSES; $C_{17}H_{34}O$, CIRCLES.

that the chief difference between the lattice of a paraffin and a ketone is the presence of layers of dipoles in the latter. Except in the methyl ketones, the potential energy of dipoles in a layer is apparently without influence on the potential energy in other layers. A check on this assumption is obtained from the measurement of the latent heats of fusion, obtained from cryoscopic data. The latent heats of fusion are:

$C_{17}H_{36}$ 10·0 k.cal./mole.
$C_{17}H_{34}O$ 13·5 ± 0·4 k.cal./mole.

In the case of the isomeric ketones, deviations from the mean value do not seem to be connected in any systematic way with the position of the dipole, and are probably due to experimental errors. The results merely show the additional heat of fusion required to break up the dipole layers.

Since the dynamical properties of the paraffin and ketone lattices must be closely similar, a possible explanation of the variation in setting point in isomeric ketones may perhaps be given on purely mechanical grounds. On melting, the thermal motion of the chains has not only to overcome the orientation energy due to van der Waals forces, which will be similar to those in the paraffin, but has also to overcome the orientation energy in the dipole layers. If the long-chain molecules are compared with an assemblage of rods undergoing torsional vibrations, and clamped to one another at a position along the rod corresponding with the position of the dipole, it seems likely on account of the properties of stationary vibrations that the minimum interaction on the clamping will be found when this is situated either symmetrically in the middle, or at one end. In other words, the thermal motion of the molecules required to overcome the orienting forces in the dipole layer must be bigger when the layer is situated at a point in the chain where torsional vibrations are less efficient in leading to motion.

This interpretation of the experimental results in terms of a mechanical model can only be regarded as provisional. Obvious limitations arise from the fact that electrical[4] and thermal[1] properties of long-chain compounds indicate extensive premelting and at least a partial freedom of orientation of the molecules below the melting point. Nevertheless, the latent heats of fusion indicate that considerable orientation of the dipoles must persist in the solid. A further limitation may arise owing to differences in details of the structure of isomeric ketones not evident from powder photographs, though the structural and thermodynamic evidence does not leave much scope for uncertainty. Experiments are being made with other compounds in order to test more fully the various factors which determine a transition from solid to liquid.

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[1] Ubbelohde, A. R., *Trans. Far. Soc.*, **34**, 282 (1938).
[2] Shearer, G., *Proc. Roy. Soc.*, A, **108**, 655 (1925).
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A Heat-Labile Isomer of Vitamin A in Cod Liver Oils

IT was observed during experiments involving the keeping properties of an individual cod liver oil that the value of $E^{1\%}_{1\,cm.}$ 328 mμ determined on the unsaponifiable fraction spontaneously increased, on keeping, to a maximum after several weeks, but the total absorption determined directly on the oil did not increase. The oil had an initial $E^{1\%}_{1\,cm.}$ 328 mμ value of 0·60 when determined on the unsaponifiable matter, and 0·60, 0·62, 0·63, 0·65 and 0·54 after 1, 4, 5, 8 and 14 weeks respectively, whereas the determination on the original oil of 0·70 gave figures of 0·70, 0·69 and 0·67 after 1, 8 and 14 weeks. With tests performed on the oil itself, both by spectrographic means and colour reaction, spontaneous increase in the apparent vitamin A has been noted by others[1] and has been assumed due to extraneous substances such as free fatty acids[2,3].

From the observation that the $E^{1\%}_{1\,cm.}$ 328 mμ value increases spontaneously, it follows that either there is a chromogen present transparent at 328 mμ which is being converted to the normal vitamin A,

or there is a factor present giving absorption at about 328 mμ which is sensitive to heat and is destroyed during saponification. The former supposition cannot be correct, since the gross absorption does not increase simultaneously but, in fact, remains practically constant. In the latter event, isomerism would most likely account for the increase of the vitamin A with time. Smith, Stern and Young[4] have suggested the possibility of an isomeric factor of the *cis-trans* type being present in concentrates.

Experiments appear to confirm the presence of a heat-labile factor; when using cold saponification followed by cold evaporation of the ethereal solution of the extracted unsaponifiable matter, higher values for $E^{1\%}_{1\,cm.}$ 328 mμ are obtained. Tests have been made on genuine cod liver oils examined as soon as possible after extraction; some of the results, typical of the whole, are given in the accompanying table.

		A	B	C	D
Direct on oil	Day received	0·94	0·58	1·09	0·52
	After 1 week	—	—	1·08	—
	„ 2 weeks	0·93	0·60	—	—
	„ 4 „	0·89	0·62	—	0·56
Via hot unsap.	Day received	0·81	0·53	0·85	0·47
	After 1 week	—	—	0·84	—
	„ 2 weeks	0·86	0·58	—	—
	„ 4 „	0·71	0·58	—	0·49
Via cold unsap.	Day received	0·96	0·58	0·97	0·55
	After 1 week	—	—	1·06	—
	„ 2 weeks	1·03	0·60	—	—
	„ 4 „	0·78	0·55	—	0·54

Deterioration set in fairly rapidly under the particular conditions of storage, namely, full bottles at room temperature in the dark, but the figures for cold saponification generally remained above those for the hot-saponification method.

Heat evaporation of the solution of extracted cold-saponification unsaponifiable matter and also boiling the oil with alcohol lowered the figure for the value of $E^{1\%}_{1\,cm.}$ 328 mμ in comparison with that obtained by cold saponification and cold evaporation.

The possibility of an enhanced 328 mμ absorption in the cold-saponification method being due to extracted impurities difficult of volatilization at low temperatures was eliminated by experiment.

If the isomeric chromogen should prove biologically active, it follows that the value for $E^{1\%}_{1\,cm.}$ 328 mμ obtained directly on the oil would be, at least for fresh oils, a more correct indication of the vitamin content, although after general deterioration of the oil, impurities take effect and the test on the unsaponifiable matter obtained by cold saponification would have to be used.

It is hoped that full details of the experiments and further work nearing completion on this problem, including the effect of accelerators, light and temperature, will shortly be published elsewhere.

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Mechanism of Fructose Resorption in Intestine and Kidney

As demonstrated by Cori[1], fructose is absorbed from the intestine definitely more slowly than galactose and glucose. If an intermediary formation of hexose-phosphoric acid is an essential factor in the active absorption of sugars[2], it must be assumed that either the phosphorylation of fructose or the dephosphorylation of fructosephosphoric acid (or both reactions) proceeds with a definitely lower velocity than the corresponding reactions of glucose and galactose. The phosphorylation of fructose in kidney extract takes place at precisely the same rate as the phosphorylation of glucose[2]. The question now is whether fructosephosphate is dephosphorylated at a slower rate than glucosephosphate?

In an interesting paper of Goda[3], it is demonstrated that the complete conversion of fructose into glucose in the liver tissue depends on a peculiar selective dephosphorylation of the glucose component in the Emden ester; in other words, fructosephosphoric acid is not directly dephosphorylated, but only through conversion into glucosephosphoric acid.

It is suggestive to suppose that this indirect dephosphorylation of fructosephosphoric acid is the reason for the relative slowness of fructose resorption in the intestine.

I have tried to demonstrate the Goda effect in extracts of intestinal mucosa and kidney cortex.

CHANGES IN CONTENT OF ALDOSE AND KETOSE DURING ENZYMIC DEPHOSPHORYLATION OF EMDEN ESTER

	Min.	Per cent dephosphoryl.	Aldose	Ketose
Intest. mucosa	60	75	+ 3·85	− 3·75
Intest. mucosa	30	67	+ 2·24	− 3·04
Intest. mucosa	60	80	+ 3·00	− 3·34
Kidney extract	60	75	+ 2·30	− 1·75

In the kidney extract no fructose at all was liberated whereas in the mucosa extracts a part of the phosphorylated fructose was liberated.

The selective dephosphorylation was not demonstrable in concentrates of intestinal and kidney phosphatases (Albers and Albers preparations[4]), but is evidently a characteristic of the fresh tissue. That the intestinal mucosa really converts glucose into fructose appears from the data of Oppel[5]. According to Verzar[6], fructose, when given in high concentrations, is partly actively absorbed into the blood through a conversion into glucose, partly diffuses passively.

The cause of the slowness of absorption of fructose in the intestine seems therefore to be not a slow phosphorylation of fructose but a slow dephosphorylation of the fructose-6-phosphate.

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Nicotinic Acid and the Fermentation of Dextrose by the Colon-Typhoid Group of Bacteria

NICOTINIC acid has recently assumed special importance as a vitamin for certain bacteria, animals and man. Knight[1] has shown that nicotinic acid is an essential factor for the growth of *Staphylococcus*

aureus. During the same year it was demonstrated that this substance cures black-tongue in dogs and pellagra in man[2,3].

The object of our studies was to ascertain whether nicotinic acid is essential for the growth of the pathogenic members of the colon-typhoid group. The results show that although *Shigella dysenteriae* (Shiga and Flexner) and *S. Paratyphosus A* can grow in the simple peptone medium described below, the addition of nicotinic acid is essential for their active utilization of dextrose.

The basic medium was made up as follows :

(*a*) Salt solution

NaCl	0·5	per cent
$Na_2HPO_4.2H_2O$	0·25	,, ,,
KH_2PO_4	0·035	,, ,,
$MgCl_2.6H_2O$	0·03	,, ,,

Traces of iron and manganese.

These salts were dissolved in distilled water and filtered through a Seitz filter.

(*b*) To this salt solution were added sterile solutions of peptone, dextrose and nicotinic acid as desired.

In one type of experiment, 0·25 per cent peptone and 0·1 per cent dextrose were added to the salt solution. To one set of tubes 10 γ nicotinic acid was added for each c.c. of medium, while another set of the same lot served as controls. The two sets of tubes were inoculated with the same number of organisms and incubated for twenty-four hours at 37° C. Growth occurred in both sets of media. The dextrose content was examined by the Lehmann-Maquenne method. The uninoculated control contained 8·37 mgm., the culture without nicotinic acid 6·29 mgm. and that with nicotinic acid 0·93 mgm. of dextrose per 9 c.c. of media.

In another type of experiment we varied the amount of peptone. To one set of tubes was added 10 γ of nicotinic acid per c.c., while to the other set no nicotinic acid was added. The sugar content of the various tubes after 48 hours incubation was as follows :

Per cent peptone	With nicotinic acid mgm. dext./9 c.c.	Without nicotinic acid mgm. dext./9 c.c.
0·1	3·99	7·24
0·2	0·76	7·24
0·3	0·62	7·35

These and other data show that although the dysentery bacilli and paratyphoid *A* grow in the peptone-glucose medium to which no nicotinic acid has been added, the glucose content is only slightly diminished even after forty-eight hours incubation. The addition of nicotinic acid stimulates the prompt and active utilization of the glucose with the formation of acid. The nicotinic acid apparently acts as a cozymase. It should be noted that even in media containing nicotinic acid, paratyphoid *A* ferments glucose with the production of acid but fails to produce gas. Paratyphoid *B*, on the other hand, ferments glucose with gas production in the medium without nicotinic acid (behaving in this respect like *B. coli*). The enzymic systems of the two species of paratyphoid are thus fundamentally different.

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[1] Knight, B. C. J. G., NATURE, **139**, 628 (1937); *Biochem. J.*, **31**, 731 (1937).
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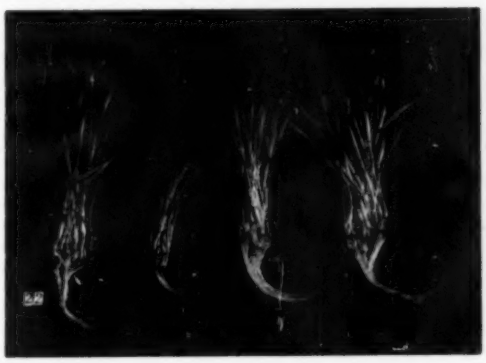
Phytohormones and Seed Disinfection

THE formaldehyde method of disinfecting cereal seeds for smuts often results in substantial reduction in germination and in retarded growth. It has been found that the addition of 1/100–10 ppm. of phytohormone chemical to the treating solution greatly reduces, or entirely prevents, formaldehyde damage. This effect is obtained with 3-indolylacetic, *l*-naphthylacetic and phenylacetic acids, and with a number of other physiologically active chemicals. Certain plant extracts and vitamin B_1 also reduce this type of seed injury. The accompanying photograph illustrates the effect of adding phytohormones to formaldehyde solution of standard concentration (1 part 40 per cent formaldehyde to 320 parts water).



REWARD WHEAT PLANTED IN SOIL, 1 DAY AFTER FORMALDEHYDE TREATMENT. PLANTS WASHED OUT AND PHOTOGRAPHED 19 DAYS AFTER PLANTING. EACH GROUP REPRESENTS THE TOTAL NUMBER OF PLANTS GROWN FROM 50 SEEDS. LEFT TO RIGHT: CONTROL (UNTREATED), FORMALDEHYDE, FORMALDEHYDE WITH 1/10 PPM. 1-NAPHTHYLACETIC ACID, FORMALDEHYDE WITH 1 PPM. 3-INDOLYLACETIC ACID.

The damage caused by disinfecting seed with copper sulphate and mercuric chloride is also reduced by the addition of a small amount of phytohormone. By a similar method, marked improvement is produced in the germination and growth of seed treated with hot water for smut control. The use of these active chemicals as an accessory to seed disinfection may thus be of value in agricultural practice. It has also been found that these responses of seed to physiologically active chemicals may be used to indicate the activity of new chemicals and extracts.

A more detailed account of this work will appear shortly in the *Canadian Journal of Research*.

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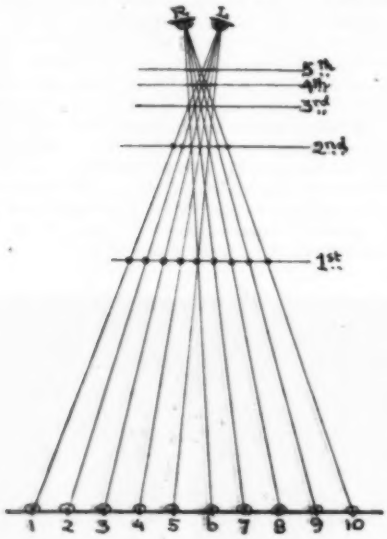
A Binocular Illusion

THE following may be added to Dr. R. S. Creed's letter in NATURE of May 28, p. 977.

In the case of a well-defined pattern, for example, alternate squares of black and white, the distance between centres of the pattern being about equal to that between the observer's eyes, it is easy to make the 'suspended' pattern appear at any one of five

different distances. With the original pattern about 90 cm. distant, the nearest 'suspension' (in my own case) is at about 9 cm. from the eyes—the others being at about 11·5, 15·5, 22 and 42 cm. respectively.



The distance of the suspension depends on the degree of convergence of the eyes and is most easily adjusted by fixing the eyes on, say, the observer's own thumb nail and moving it to and fro in front of the patterned surface. At about the distances mentioned, the observer's thumb suddenly seems to be floating on the 'suspended' surface. The apparent size of the pattern decreases in proportion to its apparent distance from the eyes.

The principle involved is shown in the accompanying drawing. At the first suspension the right eye, R, is looking at element 6 of the pattern, while the left eye, L, is looking at 5, while the observer's mind assumes that both eyes are looking at the *same* element; the pattern is therefore seen suspended at the distance at which the two lines of sight converge. In the 5th suspension, R is looking at element 10, while L is looking at element 1.

It seems clear that in these experiments the angle of convergence of the eyes is the determining factor in producing the illusion of distance.

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Points from Foregoing Letters

Prof. E. V. Appleton and K. Weekes have shown the existence of a lunar tide in the Kennelly-Heaviside layer, which is accompanied by a relative pressure oscillation 6,900 times as large as the corresponding lunar pressure oscillation at ground-level.

A table and graphs showing the rate of flow of liquid helium II through capillary tubes, as determined by H. E. Johns and J. O. Wilhelm, and Dr. H. Grayson Smith, are submitted by Prof. E. F. Burton. The results differ from those of Allen and Misener and of Kapitza in showing a normal rate of flow without any tendency to 'super-fluidity'.

From the number and energy of secondary electrons produced by the more penetrating cosmic ray particles traversing a 2-cm. plate of gold, J. G. Wilson, using Bhabha's calculations, concludes that the observed number of secondary electrons can be explained by the elastic collisions of the penetrating rays with electrons, assuming that the former have a mass rather greater than a hundred times that of the electron.

Dr. A. Shalnikov reports anomalous properties of superconducting lead and tin films condensed on to glass at 4·2° K. The transition temperatures were higher than for the bulk metals, the currents required to restore resistance were much lower than those predicted by Silsbee's hypothesis, and the magnetic fields required to restore the resistance were much higher than for the bulk metal. All these anomalies were modified if the film was warmed to room temperatures and re-cooled, and for tin the transition temperature became about the same as for the bulk metal, so it is probable that the anomalies are partly connected with the structure of the films.

Experimental values are given by Dr. A. R. Ubbelohde and J. W. H. Oldham for the setting points of isomeric ketones of the general formula $C_{17}H_{34}O$ and $C_{18}H_{36}O$. The setting points are considerably higher when the carbonyl group is at one end or symmetrically in the middle of the chain. A possible interpretation of these observations, in terms of a mechanical model, is considered in the light of the structural and thermodynamic evidence.

From the observation that in a cod liver oil the absorption at 328 mμ determined on the unsaponifiable fraction increases spontaneously with age, whereas the gross absorption of the oil does not increase simultaneously, Dr. D. C. Garratt infers the presence of an isomer of vitamin A which is being converted to the normal form but is destroyed by saponification. Cold-saponification experiments tend to confirm this supposition.

Experiments by H. Kalckar on the rate of dephosphorylation of Emden ester by fresh tissue of intestinal mucosa and kidney extract indicate that the cause of the slowness of absorption of fructose in the intestine is not a slow phosphorylation of fructose but a slow dephosphorylation of the fructose-6-phosphate.

I. J. Kligler and N. Grosowitch find that although the dysentery and paratyphoid bacilli can grow in peptone-glucose media in the absence of nicotinic acid, they cannot in those circumstances utilize glucose. Paratyphoid *B*, on the other hand, needs no nicotinic acid in order to utilize glucose.

Photographs are submitted by N. H. Grace showing that the addition of very small amounts of plant hormones (3-indolylacetic acid, *l*-naphthylacetic acid and phenylacetic acid) to wheat grains which have been disinfected with formaldehyde, reduces or prevents the slowing down of germination and growth which otherwise follows disinfection.

Research Items

Tokelau Islands

THE culture and ethnology of the Tokelau Islands, a group of four islands south of Samoa and east of the Ellice Islands, was studied during a two months' visit by Mr. Gordon Macgregor from October until December 1932 (Bernice P. Bishop Museum, Honolulu, *Bull.*, 146, 1937). Study of the culture shows that in its linguistic, social, religious, mythological and material phases many features are common to cultures of eastern Polynesia, but have no further distribution in western Polynesia, except in the neighbouring Ellice Islands. Of the material traits in particular, many with eastern affinities are found in western Polynesia, in contradiction to the theoretical western material culture complexes put forward by previous writers. Hiroa, who has made the latest grouping of Polynesian material, has shown that a fundamental culture is common to both eastern and western islands. The analysis of Tokelau culture is summarized as follows: A migration of people moving through Micronesia passed through the Tokelau Islands and into the eastern Polynesian area. This people left a small number of their group in the Tokelau Islands, where they were the first settlers and the bearers of the so-called eastern Polynesian culture traits now found in the Tokelau culture. A movement of people from Samoa to the islands of the north-west, through which their ancestors had probably come to settle Samoa, reached Fakaofu, introducing Samoan culture, and ultimately conquering the whole group. During the whole period of settlement of the Tokelau Islands, there was a small but constant drift of Polynesians, brought by the trade winds from the eastern area, who introduced locally developed eastern cultural traits and reinforced the early culture. There developed in the Tokelau Islands, and the Ellice Islands as well, a culture based on the early forms of eastern culture, later influenced by Samoan, or western Polynesian culture, and perhaps slightly by Micronesian cultures, which took on a form unique in Polynesia, and which must be considered a sub-culture in the western area, and in the future distinguished from the phrase "western Polynesian culture".

Anthropometry of Racial Hybrids

AN anthropometric study of certain hybrid populations has been made by Mr. J. C. Trevor (*Eugenics Rev.*, 30, No. 1). The nine populations chosen for analysis included 113 Norfolk Islanders, descendants of the *Bounty* mutineers, half-blood Sioux, Ojibwa-whites, 880 Yucatecans, Jamaican 'browns', American Negroes, Boer-Hottentot crosses, East Indian Mestizos and Anglo-Indian mixtures. Difficulty was found in obtaining comparable statistics of the parent races, and in no case could the F_1 be directly compared with the parents. Nevertheless certain significant results emerge. Comparative analysis shows that where the parental types differ markedly in any quantitative feature, such as head length or nasal breadth, the mean of the hybrids is generally intermediate, although sometimes almost coinciding with one parent. The variabilities of the hybrid population follow approximately the normal curve and appear to be unimodal. They are not, on the whole, peculiarly high or low. These results are not perhaps genetically surprising if the parent populations are themselves highly heterozygous and variable. A study of F_1 individuals from some racial cross in direct comparison with their parents would throw light on some of these questions.

Cell Size

A SERIES of careful measurements of the sizes of human lymphocytes under different conditions is utilized by Donald Mainland and Basil K. Cody (*J. Anat.*, April 1938) as a basis for a useful discussion of the significance of cell measurements. This is important, since, subsequent to the large amount of work done on this subject at the beginning of the present century, scepticism has been expressed as to the value of such measurements. The blood was obtained from two healthy young men, and the measurements of about a hundred examples from each preparation were taken. The specimens were prepared in various ways; the ordinary 'control' method followed by Wright's stain, mixing before drying with isotonic saline, hypotonic saline and isotonic formaldehyde. Spreading the film between cover-glasses it was found that those on the lower cover-glass were on the average 0·56μ greater in diameter than those on the upper. This the authors attribute to the more rapid falling of the larger lymphocytes. The noteworthy variation in size between the lymphocytes obtained in twenty-nine films from the same individual cannot be due to controllable differences in technique. In comparing the differences obtained by the film method and mounting in isotonic saline, it was found that there was much greater variability within and between the films than in the saline preparations, so that the latter furnish a more satisfactory basis for comparative observations.

Water-Absorbing Area in the Grasshopper Egg

MANY insect eggs appear to require for development an intake of additional water and oxygen from the medium surrounding them, and Bodine, in 1929, demonstrated that the increase in weight of the egg of the grasshopper, *Melanoplus differentialis*, as it develops is due to an actual increase in water content. The chitinous cuticle of the grasshopper's egg is, however, resistant to wetting and impermeable to fluids, though gases may diffuse through it, so that some special mechanism must exist for the absorption of water. Eleanor H. Slifer finds that at the posterior end of the egg a small circular area is present in the cuticle which, in contrast with the rest of the cuticle, becomes excessively thin and transparent on treatment with caustic potash solution (*Quart. J. Micro. Sci.*, 80, Part 3, 437; 1938). In this area, termed the 'hydropyle', there is a number of large cells, different from those elsewhere, and evidently constituting a secretory organ by means of which water is taken into the egg. If at an early stage of development the hydropyle is covered with water-impermeable material, development is stopped. During the twenty-five days' development at 25° C., the weight of the egg nearly doubles.

Fertilization in the Onychophora

IN some species belonging to the family Peripatidæ, the males form large spermatophores which are supposed to be deposited in the female genital opening. In *Peripatopsis*, however, the spermatophores are deposited anywhere upon the body of the female, and their route thence to the ovaries has remained problematical, though the subject of ingenious speculation. Dr. S. M. Manton has solved the problem, and the solution is different from the speculations (*Phil. Trans. Roy. Soc. London*, B, 228, No. 556). After a spermatophore has been deposited upon the skin of a female, leucocytes invade the ectoderm, and the cuticle of the body and the lower wall of the spermatophore rupture. Through this breach, the spermatozoa swim and so reach the vascular spaces. By their own activity they pass through the hæmocœl and reach the ovary, through the wall of which they force their way to the ovarian lumen, where oogonia are lying freely. Sperm heads invade the cytoplasm of the oogonia, which divide to form ova and these absorb the sperm heads and grow. In the meantime the spermatophore wall remains attached to the cuticle and closes the wound caused by the entry of the spermatozoa. In the ovary the spermatozoa, apart from fertilizing ova, provide the early ova with food needed for their growth, and they may also supply the animal itself with nourishment or other special substances.

Mycorrhiza in Garden Plants

THE mycotrophic habit has been shown to be of wide occurrence in many families of plants, and now M. A. Mostafa has shown that *Tropæolum majus* L., *Phlox Drummondii*, *Verbena officinalis* L. and *Clerodendron incrme* Geartn. Hook. show well-developed endotrophic mycorrhiza when growing in a soil which is alkaline and of a low humus content. Detailed observations of *Tropæolum* and *Phlox* have recently been published by the author (*Ann. Bot.*, New Series, 2, No. 6, 481, April 1938). The mycotrophic habit of both these species was shown to be very similar. In neither case was the fungus found in the aerial portions of the plant. From *Tropæolum*, two species of *Aspergillus*, three of *Penicillium* and single species of four other genera of fungi were isolated; from *Phlox*, two species of *Penicillium*, one of *Fusarium* and one of *Alternaria* were obtained. The fungus, outside the piliferous layer, was septate; it became septate and showed an increase in diameter of hypha after penetrating the root. Aseptic seedlings (obtained by treatment of seeds with mercuric chloride) of *Tropæolum* raised either in sand or agar cultures produced a well-developed root system but no fungus.

Variation in Keeping Quality of Apples

AT a meeting of the Industrial and Agricultural Research Section of the Royal Statistical Society on Thursday, May 26, Mr. T. N. Hoblyn read a paper entitled "A Study of the Variation in Keeping Quality of Apples in Store as illustrated by the Behaviour of the Variety McIntosh Red from an Ontario Apple Orchard". Keeping quality is markedly influenced by cultural treatment, but even in an orchard receiving uniform treatment, considerable variability occurs. Mr. Hoblyn described an attempt to evaluate such variability and to elucidate the factors affecting keeping quality. Samples of fruit were taken from similar trees in different positions in the orchard, from trees showing varying degrees of winter injury, and from trees showing inherent variability. Samples from the same trees were further divided into categories according to colour and size. The fruit was kept for eight months in two similar storage chambers, one at 36° F. and the other at 32° F., the effect of position in the store being allowed for in the experimental design. 11,520 individual apples were examined with particular reference to two forms of low-temperature breakdown, namely, 'core flush' and 'superficial scald'. Analysis of the data showed that samples from the same tree may be extremely variable but that samples from different trees vary even more. Inherent differences between trees were more important than those due to position or degree of winter injury. Core flush in apples from the same tree varied with size and colour, small red apples showing least. Scald, on the other hand, was associated most with green apples irrespective of size. The variability was discussed, and possible methods of sampling for use in different types of storage experiment were suggested.

Major Spiral of the Chromonema

BY comparing normal, desynaptic and asynaptic *Trillium*, C. L. Huskins and G. B. Wilson, in 1937, showed that the three following factors play a part in causing changes in direction of the major spiral of chromonema: (1) chiasmata, (2) the attachment, (3) random changes which may be expected to be proportional to the number of gyres which the chromonema forms. The authors have now published the data in detail ("Probable Causes of the Changes in Direction of the Major Spiral in *Trillium erectum* L." *Ann. Bot.*, New Series, 2, No. 6, 281; April 1938). From the analysis of these data, it appears that: (*a*) chiasmata may cause a number of changes equal to the chiasma frequency; (*b*) the direction of coiling is random on either side of the attachment, and this will cause half as many changes in direction as there are chromatid attachments; (*c*) the remaining number of changes is proportional to the number of gyres.

Protective Insecticides and Fungicides

E. Fajans and H. Martin (*J. Pom. and Hort. Sci.*, 16, 14; 1938), in continuation of their work on the physico-chemical properties which determine the retention of spray fluids and the tenacity of spray deposits, have examined sprays consisting of emulsions (liquid/liquid systems) and of added suspensions (liquid/liquid/solid systems). The initial retention of emulsions was found to be determined by the properties of the aqueous phase and intermediate between that of the emulsifier solution alone and that of water. Preferential retention of the oil phase increases as the emulsifier concentration is reduced, and is dependent on the character of the latter. Retention of emulsion-suspension systems is markedly affected by the extent of interaction between the emulsifier and the solid phase, which results in partial or complete adsorption of the oil phase by the solid, which is flocculated to large agglomerates. The stability of the emulsion is thus reduced with consequent increase in the extent of preferential retention of the oil phase followed by preferential retention of the solid phase. The tenacity of deposits from emulsion-suspension

sprays is favourably affected by the presence of oil but may be reduced by the emulsifier, for example, sulphite lye. Owing to the necessity for using sprays of high stability, only emulsion-suspension systems showing little or no interaction between emulsifier and solid can be recommended for practical use. Sulphite lye is the most suitable from this point of view, and its unfavourable effect on tenacity may be reduced by reducing its concentration.

Lunar Periodicity of Earthquakes

In a recent paper (*Union Géod. Géoph. Intern., Publ.*, Sér. A, fasc. 15, 244–257; 1937), H. T. Stetson has studied the frequency of earthquakes in connexion with the hour angle of the moon. During the years 1918–29, 2,569 earthquakes were recorded at stations more than 80° from the origin. Arranging these according to the hour-angle of the moon referred to the meridian of the epicentre of each earthquake, he finds two maxima of frequency, at 7 and 18 hours. For the smaller district consisting of the Philippines and Japan, the maxima occurred at 6 and 21 hours. Again, for 113 deep-focus earthquakes, with depths of 100 km. or more below the surface, the maxima were at about 5 and 16 hours, and the curve representing the means of the numbers of earthquakes for lunar-hourly intervals corresponds closely with the curve of the east and west component of the lunar tidal force.

Thermometry below 1° K.

It is known that magnetic susceptibility is not appreciably useful for the purpose of denoting temperatures in the presence of any considerable magnetic field, and in many cases it is undesirable to remove the field even for short intervals in very low temperature work. W. F. Giauque, J. W. Stout and C. W. Clark (*J. Amer. Chem. Soc.*, **60**, 1053; 1938) have investigated the possibility of using the electrical resistance of finely divided amorphous carbon, and their results show that this method will be very useful at temperatures below 1° K. At 1·63° K. a carbon ink film on glass had an electrical resistance 13,700 times that at 293° K., and the rate of increase with lowering temperature was accelerating so rapidly at 1·63° that a form of carbon with a smaller temperature coefficient of resistance was desirable. The construction of amorphous carbon thermometer-heaters from lampblack is described, and the resistance of a carbon thermometer from 293° to 0·129° K. was measured; at these temperatures it was 28,062 and 58,640 ohms, respectively. One thermometer was studied over a year and its resistance was found to be constant to one per cent after initial stabilization had occurred. The increase of resistance in a magnetic field was measured at 4·2° and 1·5° K. It was found to be larger at the lower temperature and proportional to the square of the applied field at both temperatures.

Absolute Configuration of Optically Active Substances

A useful review of the methods of determining the absolute configuration of optically active substances, and of progress made within recent years, has recently been given by W. Kuhn (*Naturwiss.*, 26, 289, 305; 1938). The methods are discussed in connexion with inorganic compounds, potassium cobaltioxalate $K_3Co(C_2O_4)_3$ being taken as an example. The Cotton effect in the neighbourhood of the absorption bands, and the oscillations of the various atoms and groups in the molecule are considered, and it is shown how the configuration is arrived at. Organic compounds are then dealt with, starting with methyl ethyl carbinol, and proceeding to compounds which can be derived structurally from this compound.

Specific Ionization of Cosmic Ray Particles

D. R. Corson and R. B. Brode (*Phys. Rev.*, **53**, 773; 1938) have examined a number of cloud-chamber tracks of cosmic ray particles in which the ions were spread sufficiently to enable them to be counted. In spite of this spreading of the tracks, the energy of each particle could be measured with reasonable accuracy by its curvature in a magnetic field. The particles examined were in the energy range 0·2 – 40 M.e.v.; they were therefore slow on a cosmic ray scale. The theory of Bethe gives in this region a minimum ionization at about 2 M.e.v. followed by a slow rise at higher energies. This rise has now been found experimentally for the first time. It amounts to between 10 per cent and 20 per cent for the fastest electrons studied. The paper also contains an examination of the more heavily ionizing cosmic ray tracks observed by the authors themselves and by others. There is a relation between the mass of the particle, the curvature of the track, the density of ionization, the residual range, and the rate of change of velocity with distance, such that any two of these quantities determine the others. This is expressed in a nomogram, and it is shown that nearly all the published data on 'heavy' tracks agree with a mass 200 ± 50 times the mass of an electron.

Direct Evidence for the Neutrino

For many years the existence of a neutral particle of electronic mass has been invoked to explain the continuous energy spectrum of β-rays from radioactive nuclei. On this view the energy of all β-disintegrations is the same, and when a low energy β-particle is emitted the excess energy is given to the neutrino. H. R. Crane and J. Halpern (*Phys. Rev.*, **53**, 789; 1938) have investigated the recoil of the radioactive nucleus in β-disintegrations, and have shown that momentum relations indicate the participation of a third body. A radioactive gas (a compound of radio chlorine) was introduced into a cloud-chamber. The track of the recoiling nucleus was too short to be measured, but the expansion chamber conditions were adjusted so that the ions produced by the recoil particle formed a cluster of droplets which could be counted. The number of droplets counted was examined as a function of the electron energy, and it is found that where a low energy electron is emitted the momentum carried off by the recoiling nucleus is much larger than required to balance the momentum of the electron. Control experiments were carried out with a compound of radio phosphorus, which has a much lower upper limit to its β-spectrum, and very few of the tracks had detectable clusters at their origin. This is held to confirm the identification of the cluster with the track of the recoil nucleus.

The National Physical Laboratory

Inspection by the General Board

THIS annual event was held on June 28, when a large number of visitors, representative of numerous academic, technical and commercial institutions throughout the country were received by Sir William Bragg, chairman of the Board, Lord Rayleigh, chairman of the Executive Committee, and Dr. W. L. Bragg, director of the Laboratory. The Laboratory was thrown open to the visitors and special exhibits demonstrating the work in progress were staged in its various Departments. The time available does not permit the visitor to see all the exhibits, but amongst those of more recent or important the following were noted.

PHYSICS DEPARTMENT

The section of the Physics Department concerned with the thermal properties of materials covers a wide range both of materials and temperatures, some of the extreme examples being typified by apparatus for measuring the thermal conductivity and latent heat of fusion of refrigerants, and another for measuring the thermal properties of steels and other alloys up to temperatures of the order of 1000° C. The value and convenience of electrical methods of heat production and temperature measurement were well appreciated by a glance through the exhibits in this section.

The Acoustics Section is tackling a number of problems which will eventually contribute to the comfort of a large proportion of the population by the elimination of unnecessary noise. A thorough analysis of the noise emitted by a motor-cycle engine when running under various loads and silencing conditions has begun in a small laboratory which has just been built for these tests. The work on architectural acoustics has largely centred of late on methods of avoiding the transmission of sounds throughout large buildings such as blocks of flats or offices. In one exhibit, a slab of acoustically insulating material such as might be built into the walls of a building was clamped between two plane surfaces one of which was driven at any desired frequency or amplitude. The ratio of the amplitudes of vibration of the driver and driven surfaces was determined for various frequencies and clamping pressures.

The work which has been in progress for several years in the Radiology Section on tooth structure has employed micrographic, radiographic, and X-ray analytical methods of investigation. Tooth enamel has been found to possess a prismatic cell structure, and X-ray analysis has shown that these prisms contain preferentially oriented crystallites of an apatite (probably hydroxy-apatite) the hexagonal axes of which bear a definite angular relation to the axis of the prism in which they lie. The radiographic examination of sections of teeth has also revealed the distribution of their calcium content, and the changes in this distribution consequent on injury or attrition of the enamel at any point have been studied.

A new A.C. bridge circuit has been developed in the Electrical Standards Section, by which capacitance and power factor can be determined in terms of the fundamental standards of mutual inductance and resistance. A completely screened variable substandard mutual inductance incorporating a compensating circuit, which ensures perfect quadrature of secondary E.M.F. and primary current, forms an essential part of the apparatus. The equipment is designed for measurements on capacitances ranging from 500 $\mu\mu$ F. to 4 μ F., and the limits of error at 1,000 cycles per second are of the order of $\pm$ 3 parts in 10^5.

The Electrotechnics Section still has a considerable amount of work in hand in connexion with the testing of substandard apparatus for supply authorities throughout Great Britain, and reflecting dynamometer wattmeters have been installed to facilitate the progress of the A.C. instrument testing, which has hitherto been carried out entirely with electrostatic instruments. In the High Voltage Laboratory a new battery of condensers for the generation of transient currents of the order of 100,000 amperes was shown in operation.

A portable telephotometer which has been in use for some years for the measurement of atmospheric transmission over distances up to about a mile was exhibited in the Photometry Section. This instrument is based upon the Maxwellian view principle, and by means of a Lummer-Brodhun prism the intensity of the light received from the distant source is matched by that from a lamp in the instrument. The matching has been found to depend on the size of the image which is formed in the plane of the eye-ring. For reliable measurements, the dimensions of this image should not exceed about $\frac{1}{2}$ mm.

RADIO DEPARTMENT

Much of the work in the Radio Department is devoted to the higher frequency transmissions which have assumed increasing importance of late. An instrument for the measurement of field-strengths at frequencies of 30 Mc. per sec. and upwards consisted of a supersonic-heterodyne receiver, the amplification of which could be adjusted to a reproducible value by operating with a constant 'thermal noise' in the output circuit. By means of a radiator (also exhibited) giving a calculable field, the receiver could then be calibrated at this setting and adjusted to any desired lower sensitivity by the incorporation of calibrated attenuators or voltage dividers in the amplifier. A direction-finding receiver used in conjunction with a cathode ray oscillograph for giving visual indications of bearing was also shown. This incorporated two separate amplifiers of closely identical characteristics—a condition on which the whole success of the apparatus depends.

Another interesting exhibit in this department was a very light-weight short-wave transmitter which has been developed for meteorological work. This apparatus transmits a wave with two modulations, the frequencies of which depend on the atmospheric pressure and temperature respectively, and hence when flown with a sounding balloon this transmitter gives continuous information of changes of these factors on its journey. The complete transmitter

weighs only 4½ lb. and has reached heights up to 9 miles and distances of more than 100 miles with good reception throughout.

METROLOGY DEPARTMENT

A well-designed and recently completed air-tight chamber for testing mercury barometers was seen in the Metrology Department. This provides accommodation for six barometers, including a standard, and the necessary adjustments for setting each one can be made from outside. The pressure can be varied over a wide range and held constant at any value to within ±0·01 mm. of mercury by a barostat control.

A determination of g by a reversible pendulum has just been completed. The pendulum carries two plane parallel surfaces on which it is swung from a fixed knife-edge on the supporting pillar; an arrangement with which the effective length of the pendulum may be measured with considerably greater accuracy than one in which the pendulum carries knife edges. The effect of the elasticity of the pendulum rod and the finite radius of curvature of the knife edge have been investigated in the course of this work.

In the Gauge-Testing Section a new self-contained vertical type of projector for the examination of plaster casts of ring gauges or of plug gauges up to 3 inches in diameter was shown. This apparatus is transportable and can be used in a normally lighted room.

ENGINEERING DEPARTMENT

The results of an interesting investigation on 'frettage corrosion', that is, the corrosion which occurs between two metal surfaces which are generally regarded as being in non-rubbing contact, were shown in the Engineering Department. It has been shown that the phenomenon only occurs when an alternating and microscopically small relative movement between the two surfaces occurs. Certain combinations of soft and hard metals, especially when lubricated, appear to reduce the corrosion effect, but so far no combination of surfaces has been found to be immune. In the section devoted to the study of lubrication problems, the use of ball-ball and ball-plane contacts has enabled reliable measurements to be made under boundary-layer conditions. This has been of particular value in the testing of extreme pressure lubricants. Tests on water-lubricated rubber bearings have shown that the coefficient of friction of a plane cylindrical bearing is considerably lower than that of the more usual fluted type.

A new apparatus for studying the load-relaxation of model pipe flanges at high temperatures was also seen in this Department. This consists of a very rigid frame in which a series assembly of four flanges is compressed by a hydraulic ram. The two centre flanges are thus loaded exactly as in practice, and an extensometer fitted to them measures their total compression. The whole assembly was surrounded by a furnace which could be heated up to 600° C.

METALLURGY DEPARTMENT

The accurate investigation of the iron-carbon, iron-sulphur and iron-nickel systems which is contemplated in the Metallurgy Department has necessitated the production of a regular supply of very pure iron. This is now prepared on a routine basis by chemical methods, using electrolytic iron as the raw material. The chloride is first produced and this is decomposed by steam at a carefully regulated temperature, the oxide so formed being washed free from the chlorides of other metals by water. The dry oxide is reduced in hydrogen and the metal melted, first under slightly oxidizing conditions, then in hydrogen, and finally *in vacuo*. The final product contains not more than 0·01 per cent of total impurities. The melting of iron without contamination has been made possible by the use of the high-frequency furnace and the production of crucibles of alumina and magnesia.

In this Department there were also two exhibits, one showing the automatic control of the rate of temperature change of a furnace and the other showing the automatic plotting of cooling (or heating) curves, by the combined use of which the tedium usually associated with the accurate determination of transformation points can be avoided entirely. A new gas-fired furnace with an improved design of burner was seen in the foundry. This will attain temperatures up to 1900° C. and has been used for the firing of the refractory vessels mentioned above and also for testing Seger cones as used in the ceramic industry.

AERODYNAMICS DEPARTMENT

In the compressed air tunnel of the Aerodynamics Department a large amount of data upon aerodynamic effects at high Reynolds members has been accumulated. Measurements which are in progress on model wing sections include determinations of drag, of the position of the point of transition from laminar to turbulent flow on the surface, and of pressure distribution over the surface. It will thus be possible to separate skin-friction drag from form drag, and with a knowledge of the transition point, to compare the results with predictions from modern boundary layer theory.

A model of a small airscrew in front of a thick wing was shown in the duplex tunnel. This has been used to investigate the point at which the airscrew becomes so small with respect to the wing that its efficiency begins to fall. The data so obtained will be of value in the design of large aircraft in which these conditions are most likely to occur. The extensive use now being made of kite balloons has stimulated further interest in their stability and a model of a balloon was seen undergoing tests on the whirling arm.

FROUDE LABORATORY

In the Yarrow Tank of the Froude Laboratory a tug propelled by twin paddle wheels, towing two barges, was under test. Power and speed measurements were automatically recorded, and the method of reduction to ship dimensions was explained. A model of a high-speed hull was demonstrated in the new tank. This type of work is of growing importance owing to the increasing use of small speed-boats for naval and commercial purposes.

In conclusion, a tribute might well be made here to the garden staff, which has created and maintained the pleasant surroundings in which the Laboratory is set and which help to make a visit on such an occasion as this a delight as well as an interest.

Field Days at the Rothamsted Experimental Station

TWO important meetings took place at Rothamsted on June 28 and 29. The first was a gathering of Empire agricultural officers on leave in England who were visiting Rothamsted by the joint invitation of the Station and the Imperial Bureau of Soil Science. This has now become a yearly function, and serves the double purpose of enabling Empire agriculturists to meet each other and acquaint themselves with recent work of the Station and the Soil Bureau. There was a full gathering, and no less than fifteen Empire countries were represented. The programme included a tour of the laboratories and field plots; and a brief summary of the work of the Station and the Soil Bureau was given by the Director.

The annual field inspection at Rothamsted was held on June 29, when the Right Hon. the Earl of Radnor, chairman of the Lawes Agricultural Trust, presided over a large gathering of friends and supporters of the Station. The guest of honour was the Right Hon. the Earl of Feversham, Parliamentary Secretary to the Ministry of Agriculture and Fisheries.

The morning was devoted to a visit to the famous field experiments, the Park grass plots showing the effects of fertilizers on meadow hay, and Broadbalk with its striking series of wheat plots. Broadbalk, now carrying its ninety-fifth successive crop of wheat, was in first-class order, and showed splendid standing crops where complete manuring had been given. Attention was not confined to the classical fields, and this year the guests were conducted over a modern grazing experiment on High Field carried out in co-operation with the Royal Agricultural Society of England. The purpose of this experiment is to evaluate the fertilizing effect of the residues left behind when concentrated feeding stuffs are fed to cattle at pasture. Tenant right valuers at present use the old and well-known tables of Hall and Voelcker in estimating the compensation due to an outgoing tenant arising from the consumption of concentrated foods on grass, and the present experiment will show whether in present conditions they still remain the most suitable basis, and if not, what should be done to replace them.

In his chairman's address, Lord Radnor stressed the importance of the work on soil fertility in which Rothamsted was engaged. With our shrinking cultivated area and the progressive exhaustion of virgin soils overseas a time would soon come when food production from our home soils would be a vital problem. Knowledge gained now and put in a form that farmers could readily use would serve to meet the demands that sooner or later would be made upon our agriculture. To make full use of its opportunities the Station equipment had to be brought completely up to date, and it was hoped to raise a sufficient sum to have this completed by the centenary, which would be celebrated in 1943.

Speaking of the contribution of Rothamsted to agriculture, Lord Feversham acknowledged the assistance that the Ministry of Agriculture had received from the Station in connexion with the Land Fertility Scheme. The recent work carried out in pasture problems had been of great value in this connexion. He had pleasure in announcing that the Government had granted £14,500 to meet half the cost of the new wing to accommodate the Departments of Chemistry and Biology; while plant physiology was to be housed in a separate building. This money was well spent and would undoubtedly give a good return for the outlay. The taxpayer had frequently been called upon in recent years to make contributions to the agricultural industry. There should be no appearance of subsidizing obsolete methods. One of the functions of agricultural research was to ensure that farmers should have at their disposal trustworthy information on which to base efficient production.

Sir John Russell than gave a brief outline of the work of the Station. Agriculture was at present passing through a period of depression; some people were turning to politics and others to economics as a remedy for the present situation, but these fields were outside the scope of the Station's activities. The purpose of the Rothamsted work was to provide sound technical knowledge and put it out to farmers in such a way that costs could be lowered or output increased. The resources of the Station were amplified in two directions: In pure science the Rothamsted work was linked up with investigations in highly specialized fields; with Prof. V. H. Blackman, for example, in plant physiology, and with Sir William Bragg at the Royal Institution. On the other side, the Station owed much to the co-operation of expert users of agricultural produce. Thus the Institute of Brewing gave valuable help in the study of barley problems, and the experts of the Sugar Commission in the study of the production of sugar beet. Progressive farmers all over Great Britain allowed the Station staff to carry out experiments on their land under conditions of actual agricultural practice.

Processes of Urine Formation*

THE controversies which, in the past, have characterized the experimental literature on the nature of renal function have resulted in large part from lack of information concerning the composition of urine at different stages of its elaboration within the structural units of the kidney. The discovery that the kidneys of amphibians and of reptiles can be subjected to direct microscopic observation during life indicated that a way of obtaining such information might be found.

Microdissection methods, as developed by Barber, Kite and Chambers, applied to the kidneys of these animals, have made possible the collection of minute specimens of fluid from Bowman's capsule and from various levels of the uriniferous tubules. Quantitative analyses of these specimens show that with

*Substance of the Croonian Lecture delivered by Prof. A. N. Richards, University of Pennsylvania, before the Royal Society on June 30.

respect to every constituent for which an analytical method could be devised, the fluid as separated from blood plasma in the glomerulus has the composition of a protein-free plasma filtrate. The blood pressure in the capillaries of individual glomeruli has been measured and found to be significantly higher than the colloid osmotic pressure of the plasma. Hence the conclusion seems inescapable that the glomerular process in these animals is physical filtration.

Analyses of fluid collected from the tubules have shown that the glucose of the glomerular filtrate is restored to the blood during passage through the proximal convolutions; that chloride is reabsorbed and reaction is changed from alkaline to acid by the cells of the distal convolutions. Reabsorption of water takes place in both sections of the tubule, to a greater degree in the distal than in the proximal segment.

Reasons for thinking that the conclusions drawn from these experiments with reference to glomerular function in amphibia are applicable to the mammalian kidney have been derived from study of the excretion of the polysaccharide inulin by dogs and rabbits. The results show that this substance, which, after intravenous injection, is excreted rapidly and in high concentration in the urine, finds access into the urine solely through the glomerulus. From the amount of inulin excreted in unit time and its concentration in plasma, a minimal rate of glomerular filtration can be calculated. Such calculations show that in non-diuretic dogs the volume of glomerular filtrate is more than a hundred times as great as the volume of urine elaborated from it and is sufficient to contain all the constituents of urine normally excreted, with the exception of those which are formed within the kidney (ammonia and hippuric acid).

The experiments support the view that the excretory function of the kidney is accomplished at the expense of energy derived from the heart; that the work which the cells of the kidney perform consists in the selective restoration to the blood, against osmotic gradients, of those substances, loss of which would disturb that constancy of composition of the fluid environment of tissue cells which is essential for survival.

Science News a Century Ago

Freshwater Fishes of Great Britain

THE *Athenæum* of July 14, 1838, said: "We must call the attention of our readers to the completion of a very extraordinary publication. In No. 16 of this journal (published ten years ago) our predecessors announced the commencement of Mrs. R. Lee's (then Mrs. Bowdich) work on *The Freshwater Fishes of Great Britain*, in which . . . the illustrations are not engraved, but are coloured facsimiles of the original drawings, all executed by the unassisted hand of the biographer of Cuvier—all executed, too, without the slightest relaxation of pains and finish. The fish have been, in the first place, drawn from life, immediately on the specimens being taken out of the water. This process may account for a greater gaiety and delicacy of colouring, in some of the specimens, than are familiar to the eyes of those who may have been used to examine fish some time after their capture. . . . A review of the whole work is here impossible; but now that it is completed, we ought to commend it to the notice of all who are interested in the subject, were it only as a remarkable—we believe, in England, unique—evidence of female energy and perseverance."

Mrs. Sarah Lee, née Wallis, was born in 1791 and in 1813 married the African explorer Thomas Edward Bowdich (1791-1824). Five years after his death she married Robert Lee. With her first husband she had studied in Paris and at one time been an inmate of Cuvier's house, and in 1833 she published her "Memoirs of Baron Cuvier". In 1854 she received a Civil List pension of £50. She died at Cork in September 1856.

Magnetism of Iron Ships

ON July 14, 1838, Captain (afterwards Rear-Admiral Sir) Francis Beaufort (1774–1857), then hydrographer to the Navy, wrote to the Astronomer Royal, Airy, that the Admiralty wished him to make experiments on compasses in the iron steam vessel *Rainbow*, and a week later the Admiralty gave Airy full powers to proceed. The experiments were carried out in the basin at Deptford Dockyard during the course of the summer. Among his notes on the work, Airy recorded: "On Aug. 17th and 18th I measured the intensity of some magnets, to be used in the ship for correction. It is to be remarked that, beside the effect of polar magnetism, there was no doubt of the existence of an effect of induced magnetism requiring correction by other induced magnetism; and experiments for this were made in the Magnetical Observatory. All was ready for trial: and on Aug. 20th I carried my magnets and iron correctors to Deptford, mounted them in their proper places, tried the ship, and the compass, which had been disturbed 50 degrees to the right and 50 degrees to the left, was now sensibly correct. On Aug. 21st I reported this to the Admiralty and on Aug. 24th I tried the ship to Gravesend." The results of Airy's experiments were published in the *Philosophical Transactions* on April 25, 1839 under the title, "Account of Experiments on Iron-built Ships, instituted for the purpose of discovering a correction for the deviation of the Compass produced by the iron of the Ships".

Sir James Anderson and Steam Waggons

AMONG the many pioneers of steam road carriages was the Scottish baronet Sir James Caleb Anderson (1792–1861). He took out several patents and his water-tube boiler for steam carriages was described in the *Mechanics' Magazine* of June 16, 1838. A month later, on July 14, the Editor published a letter from Anderson in the course of which he said, "I have spent nearly two *apprenticeships* to this undertaking, and have unaided by any company expended about £30,000 on my experiments. These have never been brought before the public, for I did not consider my carriage, until the present time, equal to the difficulties to be overcome. And I now give the measure into the hands of a company, *because it is of paramount importance to the country, that locomotion on common roads should be introduced as widely and expeditiously as possible*, which cannot be done individually, otherwise my partner and myself would have worked it for our own benefit.

"If the public find my steam drag answer, it will but prepare the way for those of greater talent to introduce them. Capital can never be wanted for what is really good; and the public are now awakening to the necessity for locomotion on common roads."

University Events

BIRMINGHAM.—It is announced that the General Electric Co. wishes to give £10,000 to endow two scholarships in celebration of the jubilee of the Company. In the letter offering the gift, Lord Hirst, chairman of the Company, says: "Bearing in mind our intimate connexion with Birmingham which goes back some 40 years, as well as the close interest we have always taken in the development of the University of Birmingham, we have decided to put at the disposal of your Council a sum of £10,000 for founding two post-graduate scholarships in electrical engineering. We sincerely hope that this gift may still further strengthen the bonds existing between industry and our Universities in general, and between the General Electric Co., the City of Birmingham and the University of Birmingham in particular."

The Brewers' Society has guaranteed funds to provide scholarships of £100 per annum for training graduates who wish to take a course leading to the degree of B.Sc. in industrial fermentation and a post-graduate course in malting and brewing.

The Anglo Iranian Oil Co., the Asiatic Petroleum Co. and the Burmah Oil Co. have guaranteed a fund for providing scholarships, of value more than £100 per annum, for students entering the oil industry, tenable at the Oil Engineering and Refining Department of the University.

The following lecturers have recently been appointed: Miss L. Phillip in hygiene and physical training; Dr. Thelma Mouat in bacteriology; and Dr. R. W. Pohl in electrical engineering.

CAMBRIDGE.—The Frank Smart Prizes awarded in connexion with the Natural Sciences Tripos have been gained by J. L. Crosby, Magdalene (botany), R. G. Goode, Gonville and Caius (zoology), and Miss M. R. Osborn, Newnham (zoology).

The Harkness scholarship for proficiency in geology including palæontology, value £150, has been awarded to W. B. Harland, Gonville and Caius College, who was placed in the first class of Part II, Natural Sciences Tripos.

EDINBURGH.—At a graduation ceremonial on July 1 the degree of D.Sc. was conferred on the following for the theses indicated: Dr. B. N. Desai, "Importance of Dialysis in the Study of Colloids"; Dr. A. Haddow, "Studies in the Biology of Cancer"; A. G. MacGregor, "The Volcanic History and Petrology of Montserrat, with Observations on Mt. Pelé, in Martinique"; Dr. E. G. V. Percival, "Studies in the Carbohydrate Field"; I. A. Galloway, "Studies on Certain Viruses Pathogenic for Man and Animals".

LONDON.—The Earl of Athlone, chancellor of the University, will open the new arts building of Queen Mary College on October 12. This new wing, which is being completed at a cost of £50,000, will be available for teaching and research when the new session opens on October 4 next. The top floor will be used for the teaching of zoology. Queen Mary College is being largely rebuilt and modernized at a total estimated cost of £200,000.

ST. ANDREWS.—For the triennial period 1935–38, the Senatus has awarded two Sykes Gold Medals for D.Sc. theses of unusual merit. The theses are by Dr. G. J. Robertson on "Walden Inversion in the Sugar Group" (1936), and by Dr. Ian Sandeman on "The Mathematical Representation of the Energy Levels of the Spectrum of Hydrogen" (1938).

Societies and Academies

Paris

Academy of Sciences, May 16 (*C.R.*, 206, 1421–1516)

JULES DRACH: The differential equation of the third order of the elliptic ϑ functions.

HENRI DESLANDRES: The universal constant of band spectra. Attribution of the lines of the band to other causes than the rotation of the molecule.

ERNEST ESCLANGON: The aurora borealis of May 12, 1938. Description of the effects seen in the Paris region: the phenomenon was less intense than that observed in England and Germany.

GEORGES DENIGÈS: A new reaction of cystine applicable to its estimation and to its detection in urinary calculi and concretions. The reaction is based on the liberation of iodine from a solution of iodic acid acidified with hydrochloric acid. It is claimed that no other constituents of urinary calculi liberate iodine in this way.

HWA-CHUNG LEE: The transformations of Hamiltonian congruences.

CHARLES EHRESMANN: The analytical arcs of a Cartan space.

LÉON PONTRJAGIN: The classification of an $(n+1)$ dimensional complex quantity in an n-dimensional sphere.

ARYEH DVORETZKY: The singularities of analytical functions represented by Dirichlet's series.

KYRILLE POPOFF: An extension of the idea of the derivative.

VLADIMIR A. KOSTITZIN: Natural selection and the transformation of species from the analytical, statistical and biological points of view.

HENRI PAILLOUX: The equilibrium of membranes.

LÉOPOLD ESCANDE: Indeterminations and multiple solutions in flow through a submerged valve gate. Alternating phenomenon.

SVETOPOLK PIVKO: The interactions of a helix working at a fixed point with a supporting wing.

HENRI MÉMERY: An index of stability of the solar activity. The ratio of the number of sunspots to the frequency is approximately constant, varying only between 5·7 and 6·1 over a period of 56 years.

BOHUSLAV HOSTINSKY: The solution of a general problem of the theory of diffusion.

GÉRARD PETIAU: The proper function of the fundamental operators of Dirac's theory of the electron.

JEAN ROUBAUD-VALETTE: The nature of the electromagnetic field in limited relativity.

EMILE ELCHARDUS: Study of the surface tension of fused mixtures containing cryolite.

MLLE. NINE CHOUCROUN and MAURICE ARDITI: The measurement of superficial electric moments in the midst of a liquid.

OUANG TE-TCHAO and MLLE. ANNE MARIE MOULIN: The state of equilibrium between large ions and the ions produced by X-rays in a gas.

MLLE. JEANNE BRIGANDO: The comparative study of some complex bases.

RAYMOND CHEVALLIER and MLLE. SUZANNE MATHIEU: The magnetic properties of ferric hydroxide.

LOUIS NÉEL: The paramagnetism of electrons in a rectangular band.

HUGO STEINHAUS: The localization of objects by means of X-rays.

JACQUES DUCLAUX and MIGUEL AMAT: Ultra-filters of graduated porosity. A method based on the solubility of cellulose acetate in aqueous solutions of magnesium perchlorate. These solutions coagulate instantaneously in contact with water and give a porous film. The concentration of the cellulose acetate determines the porosity.

R. GRÉGOIRE: The mass numbers of the stable isotopes of the elements 43, 61, 85 and 87.

MLLE. MARIE FALINSKI: A basic zirconium sulphate obtained by hydrolysis of the normal sulphates.

MICHEL LESBRE: Complex organic compounds of lead.

JEAN DESMAROUX: The action of dilute acids on the nitrocelluloses: observation of steric hindrance. The considerable variations in the hydrolytic action of various acids are due to the fact that the large ions penetrate the nitrocellulose structure with difficulty owing to their size.

MARCEL MATHIEU and MLLE. THÉRÈSE PETITPAS: The solubility structure of the denitrated nitrocelluloses.

MAX MOUSSERON and ROBERT GRANGER: The monohalogen derivatives of methylcyclohexane.

AUGUSTIN BOUTARIC and MAURICE ENGELDINGER: Dilatometric researches on a synthetic resin.

ALFRED SILBERSTEIN: The crystalline structure of some bromocupric compounds.

RAYMOND FURON: Observations on the Nummulitic of eastern Persia.

ANTOINE BONTÉ: Phenomena of modification in the phosphatic nodules of the Toarcian of Echelle (Ardennes).

PIERRE COMTE: The facies of the Upper Devonian in the Cantabrian mountains.

PAUL WALTER: Study on the resistivity of the water of the Marne near its junction with the Seine.

VLADIMIR FROLOW: The annual component of the maximum temperature of Morocco.

JEAN FELDMANN: A new genus of Siphonocladaceæ.

FERNAND OBATON: Measurement of the brightness of *Photobacterium* as a function of its development.

ANDRÉ MIRIMANOFF and MLLE. ANNE RAFFY: Preparation of flavine in the crystalline condition starting with *Eremothecium Ashbyii*.

EMILE F. TERROINE and MLLE. BERTHE NATAF: The role of the reticulo-endothelial system in nitrogen metabolism.

DIKRAN G. DERVICHIAN and MICHEL MACHEBŒUF: The existence of a monomolecular layer of lipoid substances at the surface of the red corpuscles of the blood.

LÉON VELLUZ: Study of the comparison, in the polycyclic series, between reversible oxidability and carcinogenetic power.

Brussels

Royal Academy (*Bull. Classe Sci.*, **24**, No. 1; 1938).

L. GODEAUX: Cyclic involutions belonging to an algebraic variety and possessing a united curve.

TH. DE DONDER: Velocity of reaction (2).

G. LEMAÎTRE and O. GODART: Generalization of Hill's method.

M. FLORKIN: The cryoscopic depression of the body fluid of *Anodon* in the course of prolonged inanition.

P. HEIRMAN: Note on the distribution of a catecholoxidase in the tissues of vertebrates.

L. LISON: Comparative study of the resorptive permeability of the *néphron* of the toad (*Bufo vulgaris*) for acid and basic dyes.

O. ROZET: The cyclic involutions of order nine belonging to an algebraic surface (2).

P. VINCENSINI: Transformations of cyclic systems deduced from Laplace's equation.

Vienna

Academy of Sciences, April 28.

E. ADLER: Velocity of dissociation of polonium hydride.

ELISABETH RONA, HERTA SCHEICHENBERGER and R. STANGL: Artificial radioactivity of thorium. The products with half-periods of 1 and 12 minutes are produced by fast neutrons, while the product with a half-period of 25 minutes is produced by thermal neutrons.

J. TRINKS: Tribo-luminescence of rock-salt irradiated by radium.

H. FLASCHKA and E. GASTINGER: Degree of depolarization of the scattered radiation of binary liquid mixtures (2).

R. HERZOG: Spreading of aliphatic hydrocarbons on solid surfaces.

H. DOSTAL: Statistical theory of the elasticity of rubber (1) and (2).

N. STRANSKI and L. KRATANOW: Theory of orientated deposition of ionic crystals on one another.

E. V. BRITZKE and E. HOFFMANN: Molecular weight of P_2O_5 between 670° and 1100° C.

H. PELZER: Kinetic theory of the elasticity of rubber.

K. MURBAN: Brachiopods from the Christophberg near Pischeldorf (Middle Carinthia).

A. GINZBERGER: Supplement to "Natural History of the Scoglien and Smaller Islands of South Dalmatia" (*Denkschriften d. kais. Akad. d. Wiss. in Wien*, **92**, 261; 1915). Under the above title, was published the first of a series of reports on the geology, botany and zoology of this region. Subsequent reports are scattered among various journals and books. The present note gives a complete list of these reports, together with corrections to many of them.

May 5.

R. INZINGER: Ellipses. A representation is discussed which has the property of projecting any circle in a plane Π into a conic section in a plane π with its centre at a fixed point 0.

TH. R. WIDORN: Period of rotation of the planet Mars.

May 12.

E. CHWALLA: Theory of the stability of statically indeterminate frameworks. The case of a framework with axial loading is discussed by means of the author's method, which uses the strains in the various members, instead of forces and moments, as unknown quantities.

A. ROLLET and H. GANTZ: Silicon as a reducing agent in organic chemistry.

May 19.

S. MEYER: Simple formula for the calculation of the atomic weight from the mass number and packing fraction.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Tuesday, July 12

SOCIETY FOR THE STUDY OF INEBRIETY (11 Chandos Street, W.1), at 4 p.m.—Dr. J. D. Rolleston: "Auguste Ford and his Campaign Against Alcoholism".

BRITISH MEDICAL ASSOCIATION (at University College Hospital Medical School, Gower Street, W.C.1), at 5.—Dr. Gordon Holmes, F.R.S.: "The Cerebral Integration of the Ocular Movements" (Victor Horsley Memorial Lecture).*

Friday, July 15

INSTITUTE OF WIRELESS TECHNOLOGY, at 7.30.—S. A. Hurren: "A New System of Pianoforte Electro-Acoustics".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

LECTURER IN MECHANICAL ENGINEERING in the North Staffordshire Technical College—The Clerk to the Governors, Education Offices, Town Hall, Hanley (July 9).

CHIEF LECTURER IN MECHANICAL ENGINEERING in the Leicester College of Technology and Commerce—The Registrar (July 13).

HEAD OF THE BIOLOGY DEPARTMENT, Huddersfield Technical College—The Principal (July 13).

MECHANICAL AND ELECTRICAL ENGINEER in H.M. Office of Works—The Establishment Officer, Room 60A, Second Floor, H.M. Office of Works, Storey's Gate, London, S.W.1 (July 16).

TWO LECTURERS IN MECHANICAL ENGINEERING in the Merchant Venturers' Technical College—The Principal (July 16).

ASSISTANTS III (ENGINEERS) at the Fuel Research Station, East Greenwich—The Establishment Officer, Department of Scientific and Industrial Research, 16 Old Queen Street, London, S.W.1 (quote ref. *J* 38/8) (July 18).

DEMONSTRATOR IN PHYSICS in the University of Leeds—The Registrar (July 18).

LECTURER IN MINING in the Burnley Municipal College—The Director of Education, Education Offices, Burnley (July 18).

PROFESSOR OF CHEMISTRY in the University of Durham—The Registrar (July 25).

ASSISTANT TO THE DIRECTOR OF THE UNIVERSITY FARM, Cambridge—The Secretary, School of Agriculture, Cambridge (July 30).

LECTURER IN CHEMISTRY in the University of Cape Town—The Secretary, Office of the High Commissioner, South Africa House, Trafalgar Square, London, W.C.2 (August 19).

JUNIOR PHYSICIST to the British Rubber Producers' Research Association—The Secretary, 19, Fenchurch Street, London, E.C.3.

LECTURER IN ENGINEERING in Achimota College, Gold Coast—Mr. C. S. Deakin, 48 Copse Avenue, West Wickham.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

Royal Botanic Gardens, Kew. Bulletin of Miscellaneous Information, 1937. Pp. iv+600+16 plates. (London: H.M. Stationery Office.) 15*s*. net. [176

British Association for Labour Legislation: British Section of the International Association for Social Progress. Report on Nutrition. Pp. 118. (London: British Association for Labour Legislation.) 1*s*. 6*d*. [206

Norman Lockyer Observatory. Council's Report and Accounts and Director's Report, List of Council, Staff, Members; etc. Pp. 15. (Salcombe: Norman Lockyer Observatory.) [226

Transactions of the Royal Society of Edinburgh. Vol. 59, Part 2, No. 11: The Hairs of the Monotremata, with special reference to their Cuticular-Scale Pattern. By Dr. A. B. Wildman and J. Manby. Pp. 333–349+7 plates. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) 4*s*. 9*d*. [226

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. Vol. 237, No. 776: Flexure with Shear and associated Torsion in Prisms of Uni-axial and Asymmetric Cross-sections. By A. C. Stevenson. Pp. 161–230. 9*s*. Vol. 237, No. 777: The Law of Error and the Combination of Observations. By Harold Jeffreys. Pp. 231–272. 5*s*. Series B: Biological Sciences. Vol. 229, No. 558: Two New Echinoidea, *Aulechinus* and *Echinechinus*, and an Adult plated Holothurian, *Eotheuria*, from the Upper Ordovician of Girvan, Scotland. By E. W. MacBride and W. K. Spencer. Pp. 91–136+8 plates. 12*s*. (London: Cambridge University Press.) [226

Imperial Bureau of Animal Health. Review Series, No. 1: Bovine Mastitis; Survey of the Literature to the end of 1935. By E. Munch-Petersen. Pp. vi+272+8 plates. (Weybridge: Imperial Bureau of Animal Health.) 10*s*. [226

The Doctors' Cookery Book: 21 Menus and 82 Recipes for Family Meals. Pp. 48. (London: British Medical Association.) 4*d*. [226

Labour's Plan for Oil from Coal. Pp. 79. (London: Labour Publications Department.) 1*s*. [236

Towards a National Food Policy. Pp. 8. (London: Committee Against Malnutrition.) 2*d*. [236

University Grants Committee. Returns from Universities and University Colleges in receipt of Treasury Grant, Academic Year 1936–37. Pp. 26. (London: H.M. Stationery Office.) 1*s*. 3*d*. net. [246

Spectrochemical Abstracts, 1933–1937: being a 52 page Bibliography with Abstracts of over 200 Papers on Spectrochemical Analysis. By F. Twyman. Pp. 52. (London: Adam Hilger, Ltd.) 4*s*. [246

British Non-Ferrous Metals Research Association. Research Reports, Association Series, No. 472: Nickel Silver; a Survey of Published Information. By T. F. Pearson. Pp. 36. (London: British Non-Ferrous Metals Research Association.) 3*s*. [246

The Therapeutic Application of the B.D.H. Sex Hormones in Gynæcology and Obstetrics. Pp. 64. (London: British Drug Houses, Ltd.) [246

Other Countries

Essential Facts about the League of Nations. Ninth edition (revised). Pp. 349+9 plates. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 1*s*. [146

Industrial Research Bureau. Bulletins of Indian Industrial Research, No. 11: The Manufacture of Sulphitation Sugar from Coloured Canes (Purple Mauritius). By S. Venkata Ramanayya. Pp. ix+25+5 plates. (Delhi: Manager of Publications.) 10 annas; 1*s*. [176

Ceylon. Sessional Paper 4: Report and Accounts of the Coconut Research Scheme for 1937. Pp. 21. (Colombo: Government Record Office.) 25 cents. [226

Report of the Aeronautical Research Institute, Tôkyô Imperial University. No. 162: Chemical Structure and Viscosity Characteristics of Lubricating Oils. By Bunnosuke Yamaguchi. Pp. 211–235. 0.40 yen. No. 163: On the Influence of a Resonator upon the Sound Field. By Kôzi Satô and Keiiti Kubo. Pp. 236–244. 0.20 yen. (Tôkyô: Kôygô Tosho Kabushiki Kaisha.) [226

Smithsonian Institution: Bureau of American Ethnology. Bulletin 117: Historical and Ethnographical Material on the Jivaro Indians. By M. W. Stirling. Pp. xi+148+38 plates. (Washington, D.C.: Government Printing Office.) 35 cents. [226

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 27: Printed Page and the Public Platform; a Study of the Relation of Reading to Forums and Discussion. By John Chancellor, with the assistance of Chester S. Williams. Pp. vi+100+5 plates. 20 cents. Bulletin, 1937, No. 34: Industrial Arts; its Interpretation in American Schools. Report of a Committee appointed by the Commissioner of Education. Pp. vi+125. 15 cents. (Washington, D.C.: Government Printing Office.) [226

Queen Victoria Memorial, Salisbury. Annual Report for the Year ended 31st March 1938. Pp. 8. (Salisbury: Rhodesian Printing and Publishing Co., Ltd.) [226

Report for the Year 1937 of His Majesty's Astronomer at the Cape of Good Hope to the Secretary of the Admiralty. Pp. 9. (Cape of Good Hope: Royal Observatory.) [226

Ministry of Agriculture, Egypt. Technical and Scientific Service. Bulletin No. 182: Control of the Long-horn Beetle *Stomatium fulvum* (Villers) on valuable Furniture in Egypt. By Dr. M. Shafik. Pp. 9+4 plates. 25 mills. Bulletin No. 191: A Chocolate Spot Disease of Beans (*Vicia faba*). Part 1: Studies on *Botrytis sp.* as the Cause of the Disease in Egypt. By Dr. A. F. El-Helaly. Pp. ii+8+2 plates. 2 P.T. Bulletin No. 197: Contribution to the Flora of Egypt: New Additions to the Flora of Egypt. By Jos. R. Shabetai. Pp. ii+4+5 plates. 2 P.T. (Cairo: Government Press.) [226

Smithsonian Institution: U.S. National Museum. Bulletin 171: The Pleistocene Vertebrate Fauna from Cumberland Cave, Maryland. By James W. Gidley and C. Lewis Gazin. Pp. vi+99+10 plates. (Washington, D.C.: Government Printing Office.) 25 cents. [236

Transactions of the Academy of Science of Saint Louis. Vol. 29, No. 5: The Pre-Cambrian Structure of Missouri. By Howard B. Graves, Jr. Pp. iii+111–164. Saint Louis, Mo.: Academy of Science.) [246

Smithsonian Institution. Proceedings of the U.S. National Museum. Vol. 85, No. 3038: A New Genus and Two New Species of Cottoid Fishes from the Aleutian Islands. By Leonard P. Schultz. Pp. 187–191. (Washington, D.C.: Government Printing Office.) [246

Proceedings of the American Philosophical Society. Vol. 79, No. 1: Geophysical Exploration of the Ocean Bottom; Symposium arranged by the American Geophysical Union, held at the American Philosophical Society, November 26, 1937. Pp. 144+4 plates. (Philadelphia: American Philosophical Society.) [246

Catalogues, etc.

Catalog and Price List of Eastman Organic Chemicals. 29th edition. Pp. 124. (Rochester, N.Y.: Eastman Kodak Company.)

Priced Catalogue of B.D.H. Laboratory Chemicals. Pp. 204. (London: British Drug Houses, Ltd.)

The Revival of Learning: European Scholarship in the XVth and XVIth Centuries; Biblical, Linguistic and Historical Studies, the Neo-Latin Poets. (Catalogue 49.) Pp. 76. (London: E. P. Goldschmidt and Co., Ltd.)

Protamine Insulin (with Zinc) Suspension—Boots in the treatment of Diabetes Mellitus. Pp. vii+18. (Nottingham: Boots Pure Drug Co., Ltd.)

Catalogue of the Library of the late W. J. Sollas, LL.D., Sc.D., chiefly on the Subjects of Geology, Anthropology, Ethnology, Palæontology and kindred Sciences, including a number of works on Sponges. (No. 273.) Pp. 24. (London: Dulau and Co., Ltd.)